

**ETHIRAJ COLLEGE FOR WOMEN  
(AUTONOMOUS)  
DEPARTMENT OF MICROBIOLOGY  
B.Sc. MICROBIOLOGY  
SYLLABUS TO BE EFFECTIVE FROM 2018-2019**

**ETHIRAJ COLLEGE FOR WOMEN  
(AUTONOMOUS)  
CHENNAI-600 008.**

**DEPARTMENT OF MICROBIOLOGY**

**SYLLABUS**



**CHOICE BASED CREDIT SYSTEM  
OUTCOME BASED EDUCATION  
(OFFERED FROM THE ACADEMIC YEAR 2019-20)**

<b>S.NO</b>	<b>CONTENTS</b>	<b>PAGE NO</b>
1	Rules and Regulations for the Programme	1
2	Programme Educational Objectives	2
3	Programme Outcomes	3
4	Programme Specific Outcomes	4
5	Programme Profile	5
6	Evaluation pattern for CA	9
7	Rubrics for CA Evaluation	10
8	Evaluation Pattern for End Semester	11
9	Course Profile-Semester I	12
10	Course Profile Semester II	18
11	Course profile Semester III	28
12	Course profile Semester IV	33
13	Course profile Semester V	44
14	Course profile Semester VI	68
15	Course profile for Allied Microbiology ( Semester III and Semester IV)	88

## **Revised Syllabus of JUNE 2018**

Department of Microbiology is revising syllabi with effect from the academic year 2018 - 2019 with Part IV and Part V components. Part IV and Part V components will seek to build the capacity of the students and provide inputs for her social service and social analyzing capabilities.

The course duration is three years. Every academic year is divided into two semester sessions. Each semester will have a minimum of 90 working days and each day will have 5 working hours. Teaching is organized into a modular pattern of credit courses. Credit is normally related to the number of hours a teacher teaches a particular subject. It is also related to the number of hours a student spends learning a subject or carrying out an activity.

### **PREAMBLE**

The Department of Microbiology submits changes and additions suggested in the UG curriculum that are

- Improvisation of course content in Core and Elective papers.
- Repetition of course content was avoided and shifting of papers were done.

### **REGULATIONS**

#### **1. ELIGIBILITY FOR ADMISSION:**

Candidates for admission to the first year of the Degree of Microbiology course shall require to have passed Biology / Botany and Zoology / Microbiology along with Physics and Chemistry in the Higher Secondary Examinations conducted by the Government of Tamil Nadu or an Examination accepted as equivalent thereto by the syndicate of the University of Madras.

#### **2.ELIGIBILITY FOR THE AWARD OF DEGREE:**

A candidate shall be eligible for the award of the Degree only if she has undergone the prescribed course of study for a period of not less than three academic years, passed the examination of all Six Semesters prescribed.

#### **3. COURSE OF STUDY:**

The main subjects of study for Bachelor Degree shall consist of the following:

**PART – I** : Foundation Courses exclusive for Languages.

**PART – II** : Foundation English

**PART – III** : Core subjects and Allied Subjects

**PART – IV** : Non Major Electives and Soft Skills.

**PART – V** : Extension Activities / Sports / NCC.

#### **4. PASSING MINIMUM:**

A candidate shall be declared to have passed in each Paper/Practical of all subject of the study wherever prescribed, if she secured NOT LESS THAN 40% of the marks prescribed for the end semester examinations and the total marks of continuous assessment and the end semester examinations.

#### **5. CLASSIFICATION OF SUCCESSFUL CANDIDATES:**

Successful candidates passing the examinations and securing 60 percent and above in the aggregate shall be declared to have passed the examination in the FIRST class. All other successful candidates shall be declared to have passed the examination in the SECOND class.

Candidates who pass all the examination (Part I, II, III &IV) prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for ranking.

### **PROGRAMME EDUCATIONAL OBJECTIVES (PEO)**

On obtaining an undergraduate degree the students will be able to:

**PEO1:** Apply and advance the knowledge and skills acquired, to become a creative professional in their chosen field.

**PEO2:** Engage in self-directed continuous learning, aimed at global competency, which will promote professional and personal growth.

**PEO3:** Develop management skills and entrepreneurial skills, by harnessing core competencies tempered by values and ethics.

**PEO4:** Work towards achieving economic and social equity for women through application of relevant knowledge.

**PEO5:** Contribute to promoting environmental sustainability and social inclusivity.

## **PROGRAM OUTCOMES (POs)**

**PO1** - To promote and apply scientific knowledge for finding sustainable solution to solve the issues pertaining to the society/Industry.

**PO2** - Identify, analyse and formulate novel ideas to yield, substantial results in the fields of research utilizing the principles of physical and biological science.

**PO3** - Relate key concepts and scientific principles to various scientific phenomenon and their applications in day-to-day life.

**PO4** - Cultivate unparalleled comprehension of fundamental concepts relevant to basic sciences leading to an individual progress and career advancement at the national and global levels.

**PO5** - To communicate effectively their views and ideas orally/ written in English and in other related languages.

**PO6** - Design solutions for complex problems and design system components or processes that meet the specific needs with appropriate consideration for public health and safety, cultural, societal and environmental conditions.

## **PROGRAMME SPECIFIC OUTCOMES (PSOs)**

**PSO 1** – Outline the History, Systematics, Biodiversity, Morphology and Physiology of Microorganisms.

**PSO 2** - Apply current techniques to Microbial systems and harness the potentials of Microorganisms in various divisions of Microbiology for betterment of mankind.

**PSO 3** – Analyse the concepts in Microbial Genetics, Immunity, Biotechnology and methods involved in diagnosis of Infectious diseases and Immunological disorders.

**PSO 4** –Evaluate the role of Microorganisms in Clinical Pathogenesis, Food Safety, Agriculture, Dairy, Bioprocessing and Pharmaceutical Industries.

**PSO 5** – Utilize Analytical, Computer and Statistical skills in various fields of Life Sciences.

**PSO 6** –Apply Communication skills, Core values and Environmental awareness with Social responsibility for Entrepreneurship and Employability.

**PROGRAMME PROFILE-B.Sc., MICROBIOLOGY**

SEM	PART	COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/ WEEK	TOTAL HOURS	CA	SE	TOTAL
<b>I</b>	Part I		Language I	3	6		40	60	100
	Part II		English-I	3	4		40	60	100
	Part III	MB18/1C/FM1	Fundamentals of Microbiology-I	5	7	105	40	60	100
	Part III		Allied Biochemistry -I	4	4		40	60	100
	Part III	MB18/2C/PR1	Basic Techniques in Microbiology	-	3		-	-	-
	Part III		Allied Biochemistry Practical	-	2		-	-	-
	Part IV	MB18/1N/PCH 1a/b/c	Pet Care and Hygiene	2	2	30	-	-	50
	Part IV		Soft Skill	3	2		-	-	50
<b>II</b>	Part I		Language II	3	6		40	60	100
	Part II		English-II	3	4		40	60	100
	Part III	MB18/2C/FM2	Fundamentals of Microbiology-II	5	7	105	40	60	100
	Part III		Allied Biochemistry –II	4	4		40	60	100
	Part III	MB18/2C/PR1	Basic Techniques in Microbiology	4	3	90	40	60	100
	Part III		Allied Biochemistry Practical	2	2		40	60	100

	Part IV	MB18/2N/GAL 1a/b/c	Gardening and Landscaping	2	2	30	-	-	50
	Part IV		Soft Skill	3	2		-	-	50
<b>Credits for I and II Semester = 46</b>									
<b>III</b>	Part I		Language III	3	6		40	60	100
	Part II		English-III	3	4		40	60	100
	Part III	MB18/3C/BAI	Basic and Applied Immunology	5	7	105	40	60	100
	Part III	MB18/3A/BIT	Allied- Bioinstrumentation	4	4	60	40	60	100
	Part III	MB18/4C/PR2	Basic and Applied Immunology	-	3		-	-	-
	Part III	MB18/4A/PR1	Bioinstrumentation, Computers and Biostatistics	-	2		-	-	-
	Part IV		Soft Skill	3	2		-	-	50
	Part IV		Environmental Studies	2	2		-	-	50
	Part I		Language IV	3	6		40	60	100
	Part II		English-IV	3	4		40	60	100
	Part III	MB18/4C/CMG	Basic concepts of Microbial Genetics	5	7	105	40	60	100
	Part III	MB18/4A/BCA	Allied - Biostatistics and Computer Application	4	4	60	40	60	100
	Part III	MB18/4C/PR2	Basic and Applied Immunology	4	3	90	40	60	100



<b>IV</b>	Part III	MB18/4A/PR1	Bioinstrumentation, Computers and Biostatistics	2	2	60	40	60	100
	Part IV		Soft Skill	3	2		-	-	50
	Part IV		Value Education	2	2		-	-	50
<b>Credits for III and IV Semester = 46</b>									
<b>V</b>	Part III	MB18/5C/BAC	Bacteriology	4	5	75	40	60	100
	Part III	MB18/5C/SAM	Soil and Agricultural Microbiology	4	5	75	40	60	100
	Part III	MB18/5C/MPL	Medical Parasitology	4	5	75	40	60	100
	Part III	MB18/5E/FMB or MB18/5E/FPT	Food Microbiology/ Food Processing Technology	5	4	60	40	60	100
	Part III	MB18/5E/BIO or MB18/5E/GEG	Biotechnology / Genetic Engineering	5	5	75	40	60	100
	Part III	MB18/6C/PR3	Medical Microbiology	-	3	-	-	-	-
	Part III	MB18/6C/PR4	Applied Microbiology	-	3	-	-	-	-
		Self-Study paper	Forensic Science and Crime Investigation*	2	-	-	10 0	-	100
<b>VI</b>	Part III	MB18/6C/MML	Medical Mycology	4	6	90	40	60	100
	Part III	MB18/6C/ENM	Environmental Microbiology	4	6	90	40	60	100
	Part III	MB18/6C/VIR	Virology	4	6	90	40	60	100
	Part III	MB18/6E/INM or MB18/6E/MFT	Industrial Microbiology/ Microbial Fermentation Technology	5	6	90	40	60	100
	Part III	MB18/6C/PR3	Medical Microbiology	4	3	90	40	60	100
	Part III	MB18/6C/PR4	Applied Microbiology	4	3	90	40	60	100
<b>Credits for V and VI Semester = 47 + 2*</b>									

<b>*Self Study Paper for Advanced Learners ( students with distinction in first and second year)</b>									
<b>Part V- Extension Activity – 1 credit</b>									
<b>II B.Sc. BIOCHEMISTRY</b>									
<b>III</b>	Part III	MB18/3A/AM1	Allied Microbiology-I	4	4	60	40	60	100
	Part III	MB18/4A/PR2	Allied Microbiology Practical	-	2		-	-	-
<b>II B.Sc. BIOCHEMISTRY</b>									
<b>IV</b>	Part III	MB18/4A/AM2	Allied Microbiology-II	4	4	60	40	60	100
	Part III	MB18/4A/PR2	Allied Microbiology Practical	2	2	60	40	60	100

**PART IV- NON MAJOR ELECTIVE OFFERED BY THE DEPARTMENT**

<b>Semester</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Hours/ Wk</b>	<b>Credits</b>	<b>Marks</b>
Semester I	MB18/1N/PCH	Pet Care and Hygiene	2	3	50
Semester-II	MB18/2N/GAL	Gardening and Landscaping	2	3	50

**Part V NCC/NSS/SPORTS/CSS/SPORTS/CSS/YRC/RRC/ROT/CERTIFICATE COURSE**

**EVALUATION PATTERN FOR CONTINUOUS ASSESSMENT**

**INTERNAL VALUATION BY COURSE TEACHERS**

**CORE / ELECTIVE / PROJECT-THEORY PAPERS**

<b>S.NO</b>	<b>COMPONENT</b>	<b>TIME</b>	<b>MAX.MARKS</b>	<b>CAMARK</b>
1	TEST I	2 HRS	50 MARKS (TO BE CONVERTED)	10
2	TEST II	2 HRS	50 MARKS (TO BE CONVERTED)	10
3	ASSIGNMENT/SEMINAR/FIELD			10

	VISIT			
4	PARTICIPATORY LEARNING			10
	<b>TOTAL</b>			40

### PART III--PRACTICAL PAPERS

S.NO	COMPONENT	TIME	MAX.MARKS	CAMARK
1	TEST I	2 HRS	50 MARKS (TO BE CONVERTED)	10
2	TEST II	2 HRS	50 MARKS (TO BE CONVERTED)	10
3	MAINTENANCE OF OBSERVATION/RECORD			10
4	PARTICIPATORY LEARNING			10
	<b>TOTAL</b>			40

### CA QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K 1	A-3X2 marks	50	06	50
K1, K 2	B-3/4x8marks	500	24	
K2, K 3	C-1/2x20 marks	1200	20	

### CA QUESTION PAPER PATTERN FOR PART IV

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1, K2</b>	<b>A-5X10</b>	<b>350</b>	<b>50</b>	<b>50</b>

## **RUBRICS FOR CONTINUOUS ASSESSMENT**

<b>Assignment</b>	Content/originality/Presentation/Schematic Representation and Diagram/Bibliography
<b>Seminar</b>	Organisation/Subject Knowledge/Visual Aids/Confidence level/presentation-Communication and Language
<b>Field Visit</b>	Participation/Preparation/Attitude/Leadership
<b>Participation</b>	Answering Questions/Clearing Doubts/Participating in Group Discussions/Regular Attendance
<b>Case Study</b>	Finding the Problem/Analysis/Solution/Justification
<b>Problem Solving</b>	Understanding Concepts/Formula and Variable Identification/Logical Sequence/Answer
<b>Group Discussion</b>	Preparation/Situation Analysis/Relationship Management/Information Exchange/Delivery Skills
<b>Flipped/Blended Learning</b>	Preparation/Information Exchange/ Group interaction/Clearing doubts

## **END SEMESTER EVALUATION PATTERN**

### **THEORY PAPERS PART – III**

#### **SEMSTER - I/II/III/IV/V/VI**

Double valuation by course teacher and external examiner

Maximum marks: 100 to be converted to 60

Passing Marks: 40/100

### **PRACTICAL PAPERS**

#### **SEMSTER II/IV/VI**

Double Valuation by Internal Examiner and External Examiner

Maximum Marks: 100 To be converted to 60

Passing Mark: 40

### **PART – IV**

Single Valuation by course teacher

Written test

Maximum Marks: 50

Passing Marks: 20/50

### **Self-Study Paper**

Single Valuation by course teacher

Written test

Maximum Marks: 100

Passing Marks: 40/100

## **COURSE PROFILE- SEMESTER I**

<b>COURSE CODE</b>	<b>TITLE OF THE PAPER</b>	<b>CREDITS</b>	<b>HOURS/ WK</b>	<b>TOTAL HOURS</b>	<b>L-T-P</b>	<b>CA</b>	<b>SA</b>	<b>TOTAL</b>
	Language I	3	6			40	60	100
	English-I	3	4			40	60	100
MB18/1C/FM1	Fundamentals of	5	7	105	4-3-0	40	60	100

	Microbiology-I							
	Allied Biochemistry –I	4	4			40	60	100
MB18/2C/PR1	Basic Techniques in Microbiology	-	3					
	Allied Biochemistry Practical	-	2			40	60	100
MB18/1N/PCH 1a/b/c	Pet Care and Hygiene	2	2	30	2-0-0			50
	Soft Skill	3	2					50
	<b>TOTAL CREDITS</b>	<b>20</b>						



**SEMESTER- I**  
**FUNDAMENTALS OF MICROBIOLOGY- I**

**TOTAL HOURS: 105**  
**CREDITS: 5**

**COURSE CODE: MB18/1C/FM1**  
**L T P: 4-3- 0**

**COURSE OBJECTIVES**

1. Acquire an insight on history and developments in Microbiology.
2. Introduce eukaryotic and prokaryotic cell structure.
3. Learn the construction, working principle and application of different types of Microscope.
4. Expose them to staining techniques employed in visualizing microorganism.
5. Attain adequate knowledge on various physical and chemical sterilization methods.

**COURSE CONTENT**

**UNIT I**

**20 Hours**

History of Microbiology- Contributions of Scientists - Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Alexander Flemming, Joseph Lister. Spontaneous generation Vs Biogenesis hypothesis - Germ theory of diseases- Koch postulates. Classification of Microorganisms - Three Kingdom, Whittaker's Five Kingdom and Eight kingdom. General characteristics of acellular microorganisms - (Viruses, Viroids, Prions) and cellular microorganisms (Bacteria, algae, fungi and protozoa), Differences between prokaryotic and eukaryotic microorganisms.

**UNIT II**

**20 Hours**

Prokaryotic cell structure- cell size, shape, arrangements, capsule, slime, S layer, fimbriae, flagella, pili, Cell wall, Cell membrane, periplasmic space, ribosomes, mesosomes, nucleoid, inclusions bodies, gas vacuoles, Bacterial endospore and process of sporulation. Eukaryotic cell structure- Cytoskeleton, Cytoplasmic membrane, Golgi apparatus, Endoplasmic Reticulum, Mitochondria, Ribosomes, Nucleus and Chloroplast.

**UNIT III**

**25 Hours**

Microscopy - General Principles of optics in relation to Microscopy. Different components of Light wave - UV, IR, Visible. Principles and Applications of Microscope - Magnification, Resolving power, Numerical Aperture. Principles and Applications - Bright Field, Dark Field, Phase Contrast, and Fluorescence Microscopy. Electron Microscope - Principles, Specimen preparation and Applications of Scanning and Transmission Electron Microscopy.

**UNIT IV**

**20 Hours**

Stains and Staining Techniques - Definition of Auxochrome, Chromophores - Acidic and Basic Dyes, Natural dyes, Mordant and its functions. Classification of stains - Simple and Differential Staining. Principles and Procedures of Gram Staining, Acid Fast Staining, Endospore Staining, Metachromatic granule staining, Nuclear staining, Flagellar staining. Negative Staining - Capsule Staining.

## **UNIT V**

**20 Hours**

Methods of Sterilization- Physical Methods - Mode of Action and Applications of Heat- Dry and Moist, Pasteurization and Tyndallisation, Radiation – UV rays, X rays,  $\gamma$  rays, Filtration - HEPA filters and Membrane filters. Chemical Methods - Mode of action and applications and quality control- Alcohol, Acid, Alkali, Halogen, Heavy Metals, Phenol and Phenol derivatives, Formaldehydes, Ethylene Oxide, Detergents.

## **RECOMMENDED TEXT BOOKS**

1. Pelczar M.J., Chan E.C.S. and Kreig. N.R. (2007). Microbiology 7<sup>th</sup> edn, McGraw-Hill New York
2. Prescott L.M, Harley J.P and Klein D.A. (2013). Microbiology 9<sup>th</sup>edn, McGraw-Hill Publications
3. A.J.Salle, (1984). Fundamental Principles of Bacteriology, 7<sup>th</sup>edn, Tata McGraw-Hill Publications Ltd.

## **REFERENCES**

1. Stainer R.Y, Ingharam, Wheelis M.L. Painter (2010). General Microbiology, 5<sup>th</sup>edn Edition, MacMillan Press Ltd.
2. Tortora, G.J., Funke, B.R.,Case, C.L (2013). Microbiology-An Introduction-11<sup>th</sup>edn.
3. Madigan M.T., Martinko J.M, Parker J. (2005). Brock - Biology of Microorganisms, 11<sup>th</sup>edn, Pearson Prentice Hall International,Inc.
4. Nester E.W, Anderson D.G (2004). Microbiology-A Human Perspective, 4<sup>th</sup>edn McGraw Hill Publications.
5. Atlas.R (1997). Principles of Microbiology, 2<sup>nd</sup>edn, Wm.C.Brown publishers.

## **JOURNALS**

1. Systematic and Applied Microbiology
2. Advances in Applied Microbiology

## **E-LEARNING RESOURCES:**

1. <https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>
2. <https://study.com/academy/lesson/eukaryotic-and-prokaryotic-cells-similarities-and-differences.html>
3. [http://physics.fe.uni-lj.si/students/predavanja/Microscopy\\_Kulkarni.pdf](http://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf)
4. <https://courses.lumenlearning.com/microbiology/chapter/staining-microscopic-specimens/>
5. <https://www.cdc.gov/infectioncontrol/guidelines/disinfection/sterilization/index.html>

## **COURSE OUTCOME**

<b>CO No.</b>	<b>CO Statement</b>
CO 1	Understand the developments in Microbiology and list the contributions of various scientists.
CO 2	Illustrate the structure and function of Eukaryotic and Prokaryotic cells.
CO 3	Utilize the principles and applications of different types of Microscope.
CO 4	Apply various staining procedures for visualising microorganisms under the microscope.
CO 5	Assess the implication of various sterilisation procedures and bio safety measures in clinical labs and industries.

#### **MAPPING OF CO WITH PSO**

<b>CO / PSO</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>	<b>PSO 5</b>	<b>PSO 6</b>
<b>CO 1</b>	3	2	2	1	1	1
<b>CO 2</b>	3	2	2	1	1	1
<b>CO 3</b>	3	2	1	2	1	1
<b>CO 4</b>	2	2	1	2	1	1
<b>CO 5</b>	1	2	2	2	1	1
<b>Average</b>	<b>2.4</b>	<b>2</b>	<b>1.6</b>	<b>1.6</b>	<b>1</b>	<b>1</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

#### **TEACHING METHODOLOGY**

Lecture by chalk and talk, LCD Classes, OHP, Case history analysis, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

#### **QUESTION PAPER PATTERN**

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2 marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b> (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b> (4 questions covering any Four units will be given)	1200	<b>40</b>	

SEMESTER- I  
**NON MAJOR ELECTIVE PAPER**  
**PET CARE AND HYGIENE**  
(For other discipline students)

**TOTAL HOURS: 30**  
**CREDITS: 2**

**COURSE CODE: MB18/1N/PCH**  
**L T P: 2-0-0**

**COURSE OBJECTIVES**

- Thorough knowledge on grooming, nutrition to pets and detect, assess various ailments encountered by a pet animal.
- Train pet animals to perform good behaviours.

- Provide vaccination, record immunization schedule for pets and follow ethics in pet management.

## **COURSE CONTENT**

### **UNIT I:**

**10 Hours**

Grooming and nutrition of Pet-Introduction to pet Animals-Dog and Cat-Bathing-Grooming aids-General care- Ear, Toe nails, Teeth -Nutrition-Home diet, Nutrient requirement-Feeding. Common pet problems, such as: allergies, bad breath, ear mites, fleas, itchy skin, paw problems, teething pain, weepy eyes and wounds

### **UNIT II:**

**10 Hours**

Training of Pets -Training of Dogs-Punishment-Picking up by scruff of neck, pushing nose down-Obedience Training-Place of their own-Chewing

### **UNIT III:**

**10Hours**

Immunization of Pet Animals-Preventive vaccination procedure - Rabies, Leptospirosis, Internal and External Parasites - First aid-Emergency medicines - How to find a good veterinarian. Ethics in pet management.

## **RECOMMENDED TEXTBOOKS**

1. Tom Reed D.V. M, 1<sup>st</sup>ed, (1974) The Well Dog Books. A Rando inc.
2. Sue Dallas, Emily Jewell, (2014). Animal biology and care, 3<sup>rd</sup>edn, Wiley Blackwell.

## **REFERENCES**

1. Martin DvmGoldstein, 1<sup>st</sup>ed (1999), The Nature of Animal Healing: The Path to Your Pet's Health.
2. Richard Pitcairn (2005).Dr.Pitcairns-Complete guide for natural health for dogs and cats,4<sup>th</sup>ed,Rodale books
3. KymthySchultze, (1999), 3<sup>rd</sup>ed, Natural Nutrition for Dogs and Cats: The Ultimate Pet Diet, Paperback, Publisher: Hay House.

## **JOURNALS**

1. Journal of veterinary clinical practice and pet care.
2. Journal of Exotic pet medicine.

## **E-LEARNING RESOURCES**

1. [https://www.petsplusus.com/pet-information/health/pet-owners-guide-pet-hygiene.](https://www.petsplusus.com/pet-information/health/pet-owners-guide-pet-hygiene)
2. [https://www.thesprucepets.com/steps-to-train-your-dog-1118273.](https://www.thesprucepets.com/steps-to-train-your-dog-1118273)
3. [https://pets.webmd.com/pet-vaccines-schedules-cats-dogs#1.](https://pets.webmd.com/pet-vaccines-schedules-cats-dogs#1)

## **TEACHING METHODOLOGY**

Lecture (Chalk and Talk-OHP-LCD), Problem Solving, Group Discussion.

## COURSE OUTCOME

CO 1	Utilize the knowledge on grooming, nutrition and the various ailments encountered by a pet animal.
CO2	Use the techniques learnt to train the pets for appropriate behaviours.
CO 3	Follow immunization schedule, apply first aid and practice ethics in pet care.

## MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO3	PSO4	PSO5	PSO6
CO 1	2	1	3	2	1	2
CO 2	1	1	1	1	1	3
CO 3	1	3	2	1	1	2
Average	1.3	1.6	2	1.3	1	2.3

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

## TEACHING METHODOLOGY

Lecture by chalk and talk, LCD Classes, OHP, Case history analysis, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### Question Paper Pattern End Semester Examination

Bloom's Category	Section A	Word Limit	Marks	Total
K1, K2	10 Questions (12 Questions will be given)	350	50	50

## COURSE PROFILE- SEMESTER II

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/ WK	TOTAL HOURS	LTP	CA	SA	TOTAL
	Language II	3	6			40	60	100
	English-II	3	4			40	60	100
MB18/2C/FM2	Fundamentals of Microbiology-II	5	7	105	4-3-0	40	60	100
	Allied Biochemistry –II	4	4			40	60	100
MB18/2C/PR1	Basic Techniques in Microbiology	4	3	90	0-0-3			
	Allied Biochemistry Practical	2	2			40	60	100
MB18/2N/GAL  1a/b/c	Gardening and Landscaping	2	2	30	2-0-0			50

	Soft Skill	3	2					50
	<b>TOTAL CREDITS</b>	<b>26</b>						

*SEMESTER- II*

**FUNDAMENTALS OF MICROBIOLOGY- II**

**TOTAL HOURS: 105**  
**CREDITS: 5**

**COURSE CODE: MB18/2C/FM2**  
**L T P: 4-3-0**

**COURSE OBJECTIVES:**

1. Explain microbial nutrition, growth and culturing techniques.
2. Discuss factors affecting microbial growth.
3. Impart knowledge on various microbial metabolic pathways.



4. Describe photosynthesis process.
5. Outline the structure and mode of action of various Antibiotics.

## **COURSE CONTENT**

### **UNIT I**

**20 Hours**

Nutrition and Growth of Bacteria - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs with examples. Nutrient transport mechanisms. Culture media -Types. Microbial Growth, Generation time and Growth rate. Growth Curve and Phases of Growth in Bacteria. Batch, Continuous and Synchronous cultures. Diauxic growth. Anaerobic culture techniques.

### **UNIT II**

**20 Hours**

Measurement of Microbial growth - Quantitative Measurement of Bacterial growth by Cell mass, Cell number and Turbidity methods, Chlorophyll Estimation. Maintenance and Preservation of cultures – Sub-cultures, Mineral oil method, Lyophilisation. Reproduction - Binary fission, Mitosis and Meiosis- I and II

### **UNIT III**

**25 Hours**

An overview of Metabolism - Break-down of Glucose - Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, An overview of Mitochondria structure. Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. Chemiosmosis. ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation. Stickland Reaction.

### **UNIT IV**

**20 Hours**

Photosynthesis - An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction- Cyclic and non-cyclic Photophosphorylation. Dark Reaction - Calvin Cycle.

### **UNIT V**

**20 Hours**

Chemotherapeutic Agents – Definition of Antibiotics and Sulphonamides. Mechanism of action and Antimicrobial spectrum and Drug Resistance mechanism of Penicillin, Streptomycin, Tetracycline, Chloramphenicol, Nalidixic acid and Metronidazole.

## **RECOMMENDED TEXT BOOKS:**

1. Pelczar M.J., Chan E.C.S. and Kreig. N.R. (2007). Microbiology 7<sup>th</sup> edn, McGraw-Hill New York
2. Prescott L.M, Harley J.P and Klein D.A, (2013). Microbiology.9<sup>th</sup>edn, McGraw-Hill Publications
3. Madigan M.T., Martinko J.M, Parker J. (2005). Brock - Biology of Microorganisms, 11<sup>th</sup>edn, Pearson Prentice Hall International, Inc.

## **REFERENCES**

1. Stainer R.Y, Ingharam, Wheelis M.L and Painter. (2010). General Microbiology, 5<sup>th</sup> edn, MacMillan Press Ltd.

2. Tortora, G.J., Funke, B.R., Case, C.L (2013). Microbiology-An Introduction, 11<sup>th</sup> edn. Benjamin Cummings.
3. Lim D. (1998). Microbiology, 2<sup>nd</sup> edn, WCB McGraw Hill Publications.
4. Nester E.W, Anderson D.G. (2014). Microbiology-A Human Perspective, 4<sup>th</sup> edn, McGraw Hill Publications.
5. Wheelis M, (2010). Principles of Modern Microbiology, 1<sup>st</sup> edn. Jones and Bartlett Publication.

### JOURNALS

1. Journal of Applied Microbiology
2. Journal of Pure and Applied Microbiology

### E-LEARNING RESOURCES

1. <https://www.britannica.com/science/bacteria/Growth-of-bacterial-populations>
2. <http://www.preservearticles.com/biology/what-are-the-methods-of-measuring-microbial-growth/28473>
3. <https://www.sciencedirect.com/topics/neuroscience/metabolic-pathway>
4. <http://photobiology.info/Jones.html>
5. <http://www.biologydiscussion.com/microbiology-2/chemotherapeutic-agents/chemotherapeutic-agents-definition-and-history-microbiology/84769>

### COURSE OUTCOME

CO No.	CO Statement
CO 1	Analyse the nutritional requirement of microorganisms and their cultivation techniques under laboratory conditions.
CO 2	Utilize microbial growth, its measurement and preservation techniques in different disciplines.
CO 3	Assess various metabolic pathways occurring in microorganisms and their significance.
CO 4	Explain the stages in microbial photosynthesis and its significance.
CO 5	Acquire knowledge about antibiotics, their classification and mode of action.

### MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	2	2	2	2	2
CO 2	2	2	2	2	3	2

<b>CO 3</b>	1	2	2	2	2	2
<b>CO 4</b>	2	1	2	-	1	1
<b>CO 5</b>	2	2	2	1	2	3
<b>Average</b>	<b>1.8</b>	<b>2.2</b>	<b>2</b>	<b>1.4</b>	<b>2</b>	<b>2</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### **TEACHING METHODOLOGY**

Lecture by chalk and talk, LCD Classes, OHP, Case history analysis, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### **QUESTION PAPER PATTERN**

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b> (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b> (4 questions covering any Four units will be given)	1200	<b>40</b>	

**MAJOR PRACTICALS  
BASIC TECHNIQUES IN MICROBIOLOGY**

**TOTAL HOURS: 90  
CREDITS: 4**

**COURSE CODE: MB18/2C/PR1  
L T P: 0-0-3**

**COURSE OBJECTIVES:**

1. Focus on basic concepts in microscopy and sterilization.
2. Study about different staining techniques.
3. Learn various cultivation methods used to study microorganisms.

**COURSE CONTENT**

1. Cleaning of Glassware and Laboratory rules.
2. Microscopy - Compound microscope - Principle, Operation, Uses and Maintenance.
3. Principle and Methods of sterilization - Moist heat - Autoclave, Dry heat - Hot air oven and Filtration method - Membrane filtration technique.
4. Quality control of sterilization- chemical and biological methods.
5. Smear Preparation and Simple staining
6. Differential Staining-Gram staining
7. Endospore Staining
8. Negative Staining- Capsule Staining
9. Direct examination of Algae - *Oscillatoria*, *Volvox*, *Nostoc*.
10. Staining of fungi-LPCB - Yeast- *Candida*; Mold- *Aspergillus*, *Mucor*, *Rhizopus* & *Penicillium*.

11. Micrometry - Determination of size of Yeast.
12. Demonstration of motility by Hanging drop method.
13. Measurement of pH of medium - pH strips and pH meter.
14. Preparation of saline- Bacteriological and normal.
15. Preparation of Liquid media - Peptone Water and Nutrient Broth
16. Solid media - Basal- Nutrient agar & NA Slant, Enriched-Blood Agar, Selective - EMB agar
17. Pure culture method- Streak plate technique and study of colony morphology
18. Enumeration of bacteria– serial dilution-Pour plate and Spread plate method.
19. Antibiotic sensitivity testing - Disc Diffusion- Kirby Bauer method.
20. Biochemical analysis- Catalase, Oxidase, IMViC, Urease & Carbohydrate Fermentation

### **COURSE OUTCOME**

<b>CO No.</b>	<b>CO Statement</b>
CO 1	Apply the concept of microscopy to visualize microorganisms and methods of sterilization.
CO 2	Utilize the methodology and application of different staining techniques.
CO 3	Evaluate different cultivation methods of microorganism and its importance.

### **MAPPING OF CO WITH PSO**

<b>CO / PSO</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>	<b>PSO 5</b>	<b>PSO 6</b>
<b>CO 1</b>	3	2	3	1	1	1
<b>CO 2</b>	3	2	3	1	1	1
<b>CO 3</b>	3	2	3	1	2	1
<b>Average</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1.3</b>	<b>1</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### **QUESTION PAPER PATTERN:**

**Time: 6 Hours (3 Hrs, Two days)**

**Max Marks: 60**

**Major practical : 25 marks**  
**Minor practical : 15 marks**  
**Spotters (5 x 2) : 10 marks**  
**Record : 10 marks**

**SEMESTER – II**  
**NON MAJOR ELECTIVE PAPER**  
**GARDENING AND LANDSCAPING**  
**(For other discipline students)**

**TOTAL HOURS: 30**  
**CREDITS: 2**

**COURSE CODE: MB18/2N/GAL**  
**L T P: 2-0-0**

### **COURSE OBJECTIVES:**

1. Discuss gardening techniques and plant propagation methodology.
2. Introduce landscaping and designing
3. Learn the principles of residential landscaping.

### **COURSE OUTLINE:**

**UNIT I:** **10 Hours**  
Introduction to Horticulture - Gardening - Layout and components of a garden. Techniques in gardening – cutting, grafting, and layering. Important plant species.

**UNIT II:** **10 Hours**  
Landscaping I - Lawn making and designs.

**UNIT III:** **10 Hours**  
Landscaping II – Principles of Landscaping. Indoor landscaping, industrial landscaping and landscaping in residential areas and urban avenues.

### **RECOMMENDED TEXT BOOKS:**

1. Patrick Taylor. (1998). The Oxford companion to the Garden. 2<sup>nd</sup> Edition. Oxford University Press
2. Randhawa and Amitabha (1998). Floriculture in India. 1<sup>st</sup> Edition. Allied Publishers

### **REFERENCE BOOKS**

1. Flemer William. (1972). Nature's guide to successful gardening and landscaping. 1<sup>st</sup> Edition. Crowell publications.
2. Ann Reilly. (1990) Home Landscaper. 2<sup>nd</sup> Edition. Home Planners.
3. Black and Decker. (1998). Landscape design and construction. 1<sup>st</sup> Edition. Random House, Canada.

### **JOURNALS**

1. Journal of Horticulture.
2. Horticultural plant Journal.

### **E-LEARNING RESOURCES**

1. [http://oer.nios.ac.in/wiki/index.php/Introduction\\_to\\_Horticulture](http://oer.nios.ac.in/wiki/index.php/Introduction_to_Horticulture)
2. [http://agritech.tnau.ac.in/horticulture/horti\\_Landscaping\\_lawn%20making.html](http://agritech.tnau.ac.in/horticulture/horti_Landscaping_lawn%20making.html)
3. <https://www.landscapingnetwork.com/landscape-design/what-is.html>

## COURSE OUTCOME

CO No.	CO Statement
CO 1	Acquire knowledge on fundamentals of gardening and seed propagation.
CO 2	Apply Lawn making techniques in landscaping.
CO 3	Utilize different landscaping techniques in creating various types of gardens.

## MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	1	1	1
CO 2	3	2	3	1	1	1
CO 3	3	2	3	1	2	1
Average	3	2	3	1	1.3	1

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

## TEACHING METHODOLOGY

Teaching by showing plant specimen, OHP, LCD projector, Assignment, Quiz, Seminar, Garden diagrammatical representations.

## QUESTION PAPER PATTERN End Semester Examination

Bloom's Category	Section A	Word Limit	Marks	Total
K1, K2	10 Questions (12 Questions will be given)	350	50	50



### COURSE PROFILE- SEMESTER III

<b>COURSE CODE</b>	<b>TITLE OF THE PAPER</b>	<b>CREDITS</b>	<b>HOURS/ WK</b>	<b>TOTAL HOURS</b>	<b>L-T-P</b>	<b>CA</b>	<b>SA</b>	<b>TOTAL</b>
	Language III	3	6			40	60	100
	English-III	3	4			40	60	100
MB18/3C/BAI	Basic and Applied Immunology	5	7	105	4-3-0	40	60	100
MB18/3A/BIT	Allied-Bioinstrumentation	4	4	60	3-1-0	40	60	100
MB18/4C/PR2	Basic and Applied Immunology	-	3					
MB18/4A/PR1	Bioinstrumentation, Computers and Biostatistics	-	2			40	60	100
	Soft Skill	3	2					50

	Environmental Studies	2	2					50
	<b>TOTAL CREDITS</b>	<b>20</b>						

**SEMESTER III  
BASIC AND APPLIED IMMUNOLOGY**

**TOTAL HOURS:105  
CREDITS:5**

**COURSE CODE: MB18/4C/BAI  
L T P: 4-3-0**

**COURSE OBJECTIVES**

1. Understand the basic concepts in Immunology.
2. Impart knowledge about Human Defense Mechanisms against Infections.
3. Assess the applications of Immunological Techniques.
4. Outline Immune Response and Vaccines.
5. Acquire knowledge about hypersensitive reactions and autoimmune disorders.

**COURSE CONTENT:**

**UNIT I: 20 Hours**

Introduction - History, Scope of Immunology and Recent developments. Cells of Immune System. Hematopoiesis. Lymphoid and Myeloid Lineage. Mononuclear - Phagocytic System. Mechanism of Inflammation. Lymphoid Organs. Primary – Thymus, Bone Marrow, and Bursa of Fabricius, Secondary - Lymph Node and Spleen. Tertiary - CALT, GALT and MALT.

**UNIT II: 22 Hours**

Host parasite relationship and immunity. Introduction and classification of immunity. Innate and acquired immunity. Factors involved in immunity. Complement. Immunoprophylaxis- Importance and applications. Active and passive immunization. Advantages and disadvantages of immunization. Latest immunization schedule. Vaccine. Types of vaccines- Live attenuated, killed, subunit.

**UNIT III: 20 Hours**

Antigens and Antibodies. Antigens - Factors influencing Antigenicity and immunogenicity. Epitopes, Haptens, Super Antigen, Mitogen, Adjuvants. Antibodies – Structure, Classification, Types and Functions. Production of Monoclonal antibodies - Hybridoma technology. Antigen and Antibody Interactions. Agglutination reactions – Hemagglutination, Bacterial agglutination and Latex agglutination reactions - CRP, ASO, RF. Precipitation reactions - Double Immunodiffusion, SRID, Immunoelectrophoresis, RIA, ELISA.

**UNIT IV: 20 Hours**

Major histocompatibility complex (MHC) - Introduction, MHC genes, MHC types and pathways, Applications of MHC, Graft rejection. Transplantation Immunology.

**UNIT V: 23 Hours**

Hypersensitivity – Introduction to Hypersensitivity Reactions. Type I – Mechanism, Primary Mediators, Secondary Mediators, Symptoms and test for Type I Hypersensitivity. Type II - Mechanism and Symptoms. Type III- Mechanism and Diseases - Serum sickness, Arthus reaction, Glomerular Nephritis, Rheumatoid Arthritis. Type IV- Mechanisms & types - Tuberculin, Contact Dermatitis and Granuloma. Skin test – Immediate and Delayed. Autoimmune disorders.

**TEXTBOOKS**

1. Kuby, J. (2007). Immunology. 2<sup>nd</sup> edn. H.W.Freeman and company. New York.
2. Janeway C, Travers P, Walport M, Shlomchik M. (2001). Immunobiology .6<sup>th</sup>edn, Garland Science.
3. Stites D.P., Abba I.Terr, Parslow T.G. (1997). Medical Immunology. 9<sup>th</sup> edn. Prentice-Hall Inc. 1997

**REFERENCE BOOKS**

1. Roitt R.I. (2005). Essential Immunology. 10<sup>th</sup> edn. Blackwell Scientific Publishers.
2. Tizard, R and Isaunders. (2010). Immunology-An Introduction. 4<sup>th</sup> edn. College

- Publishing, Philadelphia.
3. Nairn, R., and Helbert, M. (2005). Immunology for Medical Students. 2<sup>nd</sup> edn. Mosby International limited.
  4. Pelczar M.J., Chan E.C.S. and Kreig N.R. (2007) Microbiology 7<sup>th</sup> edn, McGraw-Hill New York
  5. Ananthanarayan and Jayaram Panicker. (2009). Textbook of Microbiology 8<sup>th</sup> edn Orient Longman.

## JOURNALS

1. Journal of Clinical Immunology
2. **Indian Journal of Comparative Microbiology, Immunology and Infectious diseases**

## E LEARNING RESOURCES

1. <https://www.mechanobio.info> › Development
2. <https://www.cell.com> › trends › immunology
3. <https://microbiologybook.org/mayer/ab-ag-rx.htm>
4. [https://www.ebi.ac.uk/interpro/potm/2005\\_2/Page2.htm](https://www.ebi.ac.uk/interpro/potm/2005_2/Page2.htm)
5. <http://www.immunopaedia.org.za/immunology/archive/type-i-iv-hypersensitivity-reactions/immune-complex-formation/hypersensitivity-reactions/?print=print>

## COURSE OUTCOME

CO No.	CO Statement
CO 1	Acquire in depth knowledge about cells and organs of immune system
CO 2	Appraise the concepts and factors influencing immunity and vaccination.
CO 3	Elucidate the reactions between various antigens and antibodies that form the basic platform for host parasite interactions.
CO 4	Analyze graft rejection in transplantation by learning the MHC molecules and their functions.
CO 5	Illustratively assess hypersensitivity and autoimmune disorders.

## MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	3	2	3	2	2
CO 2	2	3	2	3	3	2
CO 3	3	2	3	2	1	3
CO 4	2	2	2	2	2	3
CO 5	1	1	3	2	2	3
Average	2	2.2	2.4	2.4	2	2.6

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

## TEACHING METHODOLOGY

Lecture by chalk and talk, LCD Classes, OHP, Case history analysis, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

## QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K 1	A-10x2marks (Compulsory)	One or Two Sentences	20	100
K1, K2	B-5x8 marks  (8 questions will be given covering all Five Units)	500	40	
K3,K4	C-2 x20 marks  (4 questions covering any Four units will be given)	1200	40	

**SEMESTER – III**  
**ALLIED – BIOINSTRUMENTATION**

**TOTAL HOURS: 60**  
**CREDITS: 4**

**COURSE CODE: MB18/3A/BIT**  
**L T P: 3-1-0**

**COURSE OBJECTIVES:**

1. Learn working mechanism of Fundamental laboratory instruments.
2. Study various centrifuges and electrophoresis techniques.
3. Discuss the principles and working of spectroscopy methods.
4. Study types of Chromatographic techniques with applications.
5. Learn the working of Biosensors and Radioisotopes and its applications in biology.

**COURSE OUTLINE:**

**UNIT I:** 10 Hours  
Measurement of pH- Principle and working of pH strips and pH meter. Balances- physical and electronic balances. Micropipette - working, parts and its uses. Laminar air flow, Biosafety cabinets, Incubator and BOD incubator

**UNIT II:** 15 Hours  
Centrifugation - Principle, working, uses and maintenance of Centrifuge - types of rotors and centrifuge. Electrophoresis - Definition, types - Paper Electrophoresis, Gel electrophoresis - Agarose gel, Polyacrylamide, Immunoelectrophoresis and isoelectric focusing.

**UNIT III:** 10 Hours  
Spectroscopy - Principles and Applications of Colorimetry, UV and Visible Spectrophotometry, Turbidometry, Raman Spectroscopy, Fluorimetry. Atomic absorption spectroscopy.

**UNIT IV:** 10 Hours  
Chromatography - Types, Principle and Applications of- TLC, Column Chromatography - Adsorption, Ion exchange, Affinity, Gas-Liquid, HPLC and HPTLC.

**UNIT V:** 15 Hours  
Biosensors - Definition, Components of Biosensors, Types –Electrochemical, Enzyme, Environmental Biosensors. Applications - in Medicine, Pollution control, Industry and Military. Uses of radioisotopes in life sciences, radioactive labeling, Geiger-Muller and scintillation counter, autoradiography and its application

**RECOMMENDED TEXTBOOKS:**

1. Veerakumari, L. (2009). Bioinstrumentation- 5<sup>th</sup> edn- MJP publishers, Chennai.
2. Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7<sup>th</sup>edn Cambridge university press.
3. Webster, J.G. (2004). Bioinstrumentation- 4<sup>th</sup> edn - John Wiley & Sons (Asia) Pvt. Ltd, Singapore.

**REFERENCE BOOKS:**

1. Rodney.F.Boyer, (2000), Modern Experimental Biochemistry, 3<sup>rd</sup> edn. Pearson Publication.
2. Jayaraman J (2011). Laboratory Manual in Biochemistry – 2<sup>nd</sup>edn- Wiley Eastn Ltd., New Delhi.
3. Skoog A.,West M. (2014). Principles of Instrumental Analysis – 14<sup>th</sup>edn- W.B.Saunders Co., Philadephia.
4. N.Gurumani. (2006). Research Methodology for biological sciences- 1<sup>st</sup>edn - MJP Publishers.
5. Ponmurugan. P and Gangathara PB (2012). Biotechniques. 1<sup>st</sup> edn- MJP publishers.

## JOURNALS:

1. **i-manager's Journal on Instrumentation & Control Engineering**
2. **International Journal of Instrumentation Technology**

## E-LEARNING RESOURCES:

1. <http://www.biologydiscussion.com/biochemistry/centrifugation/centrifuge-introduction-types-uses-and-other-details-with-diagram/12489>
2. <https://www.watelectrical.com/biosensors-types-its-working-and-applications/>
3. <http://www.wikiscales.com/articles/electronic-analytical-balance/>
4. <https://study.com/academy/lesson/what-is-chromatography-definition-types-uses.html>
5. <http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction>.

## COURSE OUTCOME:

CO Number	CO STATEMENT
CO 1	Acquire theoretical knowledge about basic Laboratory equipment's.
CO 2	Use the principles and applications of centrifugation and electrophoretic methods in laboratory.
CO 3	Demonstrate the use of spectroscopic techniques.
CO 4	Attain knowledge to use chromatographic techniques in research.
CO 5	Apply Biosensors and Radioisotopic analysis in research.

## MAPPING OF CO WITH PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	1	1	1	2	3	1
CO2	1	1	2	2	3	2
CO3	1	1	1	3	3	2
CO4	1	2	1	2	3	2
CO5	2	3	3	3	3	2



<b>AVERAGE</b>	1.2	1.6	1.6	2.4	3	1.8
----------------	-----	-----	-----	-----	---	-----

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**TEACHING METHODOLOGY**

Lecture by chalk and talk, LCD Classes, OHP, Case history analysis, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

**QUESTION PAPER PATTERN**

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

### COURSE PROFILE- SEMESTER IV

<b>COURSE CODE</b>	<b>TITLE OF THE PAPER</b>	<b>CREDITS</b>	<b>HOURS/WK</b>	<b>TOTAL HOURS</b>	<b>L-T-P</b>	<b>CA</b>	<b>SA</b>	<b>TOTAL</b>
	Language IV	3	6					
	English-IV	3	4					
MB18/4C/CMG	Basic concepts of Microbial Genetics	5	7	105	4-3-0	40	60	100
MB18/4A/BCA	Allied - Biostatistics and Computer Application	4	4	60	3-1-0	40	60	100
MB18/4C/PR2	Basic and Applied Immunology	4	3	90	0-0-3	40	60	100
MB18/4A/PR1	Bioinstrumentation, Computers and Biostatistics	2	2	60	0-0-2	40	60	100

	Soft Skill	3	2					50
	Value Education	2	2					50
	<b>TOTAL CREDITS</b>	<b>20</b>						

**SEMESTER – IV**  
**BASIC CONCEPTS OF MICROBIAL GENETICS**

**TOTAL HOURS: 105**  
**CREDITS: 5**

**COURSECODE: MB18/4C/CMG**  
**L T P: 4-3-0**

**COURSE OBJECTIVES:**

1. Provide knowledge on structure of DNA, RNA and plasmids.
2. Explain replication in bacteria and phages.
3. Discuss the gene expression and regulation in prokaryotes.
4. Study DNA mutation and DNA repair mechanisms.
5. Learn mechanisms of gene transfer mechanism and recombination.

**COURSE OUTLINE:**

**UNIT I: 20 Hours**

DNA as genetic material with experimental evidences– Griffith's, Avery's, Hershey and Chase's experiments. Structure of DNA. Factors that affect the Structure of DNA- Temperature, pH. Forms of DNA –A, B and Z. Supercoiling. Structure of RNA- tRNA, rRNA and mRNA. Plasmid –Classification, Structure and importance of Natural Plasmids

**UNIT II: 22 Hours**

Prokaryotic DNA Replication – Proof for Semi-Conservative Replication, Events involved in Replication fork, Enzymes involved in DNA Replication, Unidirectional and Bidirectional Replication. Rolling Circle Replication. Bacteriophage - Structure and Life cycle of Phage- Lambda, M13, T4

**UNIT III: 20 Hours**

Gene expression in Prokaryotes–Genetic Code, Transcription and Translation. Regulation of Gene Expression – Operon – lac, trp, Regulon- SOS

**UNIT IV: 20 Hours**

Mutation -Definition and Types – Spontaneous and Induced mutations. Ames test. DNA Repair Mechanism- Photo reactivation, Nucleotide repair. Excision repair, Methyl Directed Mismatch repair, SOS repair.

**UNIT V: 23 Hours**

Gene Transfer Mechanisms - Conjugation - and its uses. Transduction- Generalized and Specialized, Transformation–Natural Transformation. Transposition and types of Transposition reactions. Recombination- Homologous and Site-specific recombination.

**RECOMMENDED TEXT BOOKS:**

1. Friefelder D. (2008) Molecular Biology. 4<sup>th</sup>edn Narosa Publishing House, New Delhi.
2. Trun and Trempy, (2004) Fundamental Bacterial Genetics.1<sup>st</sup> edn Blackwell Science Ltd., Oxford.
3. Peter Paolella, (1998), Introduction to Molecular Biology, International edn, McGraw-Hill.

**REFERENCE BOOKS:**

1. Russell P.J, (2009). Genetics- A Molecular Approach. 3<sup>th</sup>edn. Pearson international
2. Old R.W. and Primrose S.B. (1985) Principles of Gene Manipulation 4<sup>th</sup>edn. Blackwell Scientific Publication, London.
3. Hays W, (1969) The Genetics of Bacteria and Viruses. 2<sup>nd</sup>edn. Blackwell
4. R.C Dubey and D.K. Maheshwari, (2007) A Textbook of Microbiology, 1<sup>st</sup> revised edn, S. Chand and company Ltd.
5. Prescott Harley Klein, (2009), Microbiology, 8<sup>th</sup>edn, McGraw- Hill International edn.

**JOURNALS:**

1. International journal of Current Biotechnology.
2. Journal of Genetics and Genomics.

**E-LEARNING RESOURCES:**

1. [https://bio.libretexts.org/Bookshelves/Introductory and General Biology/Book%3A Introductory Biology \(CK12\)/4%3A Molecular Biology/4.2%3A DNA%2C the Genetic Material](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_Introductory_Biology_(CK12)/4%3A_Molecular_Biology/4.2%3A_DNA%2C_the_Genetic_Material)
2. <https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/>
3. <https://www.nature.com/scitable/topicpage/operons-and-prokaryotic-gene-regulation-992/>
4. <https://www.eolss.net/Sample-Chapters/C03/E6-51-04-03.pdf>
5. [https://microbeonline.com/key-information-regarding-gene-transfer-mechanism bacteria/](https://microbeonline.com/key-information-regarding-gene-transfer-mechanism-bacteria/)

## COURSE OUTCOME

CO No.	CO Statement
CO 1	Apply the information on DNA and RNA structure in molecular biology.
CO 2	Discuss the knowledge in prokaryotic replication and its types.
CO 3	Use gene regulatory and expression mechanisms for research.
CO 4	Evaluate the importance of mutation and repair mechanisms.
CO 5	Analyze gene transfer and recombination methods for betterment of society.

## MAPPING OF CO WITH PSO

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	1	2	1	2	2
CO 2	1	1	3	1	1	2
CO 3	1	1	3	1	2	3
CO 4	1	1	3	1	2	3
CO 5	1	1	2	1	2	3
Average	1.0	1.0	2.6	1.0	1.8	2.6

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### TEACHING METHODOLOGY

Lecture by chalk and talk, LCD Classes, OHP, Case history analysis, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER - IV**  
**ALLIED - BIOSTATISTICS AND COMPUTER APPLICATION**

**TOTAL HOURS: 60**  
**CREDITS: 4**

**COURSE CODE: MB18/4A/BCA**  
**L T P: 3-1-0**

**COURSE OBJECTIVES**

- 1.Introduce basics of Biostatistics.
- 2.Understand Data collection and analysis.
- 3.Emphasize on various Statistical tests and their significance.
- 4.Learn about basics and operation of Computers.
- 5.Explain the importance of computers in data processing.

**COURSE CONTENT:**

**UNIT I:**

**10 Hours**

Introduction to Bio-statistics, basic concepts and role of biostatistics in modern research. Definition of data, types and its collection. Sampling and its types. Diagrammatic and graphical representation of data.

**UNIT II:**

**15 Hours**

Measure of Central Tendency- Mean, Mode and Median. Measure of Dispersion- Standard

deviation and Standard error. Probability- Definition, Random experiment, sample space and events, Mutually exclusive events, exhaustive events and equally likely events- Addition and Multiplication Laws.

**UNIT III:**

**10 Hours**

Testing of Hypothesis-Chi square, t-test, Z Score. Analysis of Variance-One way and two-way ANOVA and a few simple problems.

**UNIT IV:**

**10 Hours**

Introduction to Computer, parts of Computer, concept of Hardware and Software, types of computer and its applications. Low level and high level languages. Binary coding system. Windows – introduction and working with windows. Concept of file, folder and directories.

**UNIT V:**

**15 Hours**

Introduction to MS office software concerning word processing, spreadsheets and presentation software. Internet and its Applications. Computer oriented statistical techniques. Computation of mean and standard deviation.

**RECOMMENDED TEXT BOOKS:**

1. Pranab Kr. Banerjee. (2009). Introduction to Biostatistics, 3<sup>rd</sup>edn, S. Chand and Company Ltd.
2. N. Gurumani. (2009). An Introduction to Biostatistics, 2<sup>nd</sup>edn. MJP publishers.
3. Peter Norton (2008). Introduction to Computer, 6<sup>th</sup>edn Tata Mac Graw Hill Pub.

**REFERENCES:**

1. Norman T.J. Bailey (2004). Statistical methods in Biology, 3<sup>rd</sup> revised edn. Cambridge university press.
2. Palanichamy S and Manoharan M (1994). Statistical methods for Biologists, 1<sup>st</sup>edn. Palani Paramount Publishers.
3. Veer Bala Rastogi (2009). Fundamentals of Biostatistics, 2<sup>nd</sup>edn. Ane Books Pvt Ltd.
4. Arora and Malhan. (2009). Biostatistics, 2<sup>nd</sup>edn Himalaya Publishing House.
5. C.R. Kothari and Gaurav Garg (2014). Research Methodology-Methods and techniques, 2<sup>nd</sup> edn. New age Publication.

**JOURNALS:**

1. Biostatistics & Epidemiology - Taylor & Francis Online.
2. International Journal of Biostatistics & Computational Biology.

**E-LEARNING RESOURCES**

1. [http://web4.uwindsor.ca/users/f/fbaki/85222.nsf/0/b7d85091e772a10185256f84007be5c1/\\$FILE/Lecture\\_01\\_ch1\\_222\\_w05.pdf](http://web4.uwindsor.ca/users/f/fbaki/85222.nsf/0/b7d85091e772a10185256f84007be5c1/$FILE/Lecture_01_ch1_222_w05.pdf)
2. <https://statisticsbyjim.com/basics/measures-central-tendency-mean-median-mode/>
3. <https://machinelearningmastery.com/statistical-hypothesis-tests/>
4. <https://www.techwalla.com/articles/types-of-computers-their-functions>



5. <https://openmoodle.conted.ox.ac.uk/course/view.php?id=12>

### **COURSE OUTCOME**

<b>CO No.</b>	<b>CO Statement</b>
CO 1	Acquire information about basics of biostatistics and its application in research.
CO 2	Apply measures of central tendency and dispersion in biological analysis.
CO 3	Use hypothesis testing methods to solve research problems.
CO 4	Understand working of computers.
CO 5	Utilize computers in statistical calculations and documentation.

### **MAPPING OF CO WITH PSO**

<b>CO / PSO</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>	<b>PSO 5</b>	<b>PSO 6</b>
<b>CO 1</b>	2	2	2	2	3	2
<b>CO 2</b>	2	2	2	2	3	2
<b>CO 3</b>	2	2	2	2	3	2
<b>CO 4</b>	2	2	2	2	3	2
<b>CO 5</b>	2	2	2	2	3	2
<b>Average</b>	2	2	2	2	3	2

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### **TEACHING METHODOLOGY:**

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### **QUESTION PAPER PATTERN**

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER IV  
MAJOR PRACTICALS  
BASIC AND APPLIED IMMUNOLOGY**

**TOTAL HOURS: 90  
CREDITS: 4**

**COURSE CODE: MB18/4C/PR2  
L T P: 0-0-3**

**COURSE OBJECTIVES**

1. Learn basic concepts of Immunological Techniques.
2. Analyze the morphology and count of blood cells.
3. Understand the Principles of various Antigen and Antibody reactions

**COURSE CONTENT:**

1. Hemagglutination - Blood grouping ABO and Rh – typing- Slide method.
2. Total count of RBC
3. Total count of WBC
4. Differential count of Blood cells.
5. Separation of Buffy coat –Ficoll Hypaque method.
6. Bacterial Agglutination Test.
7. Agglutination- ASO
8. Agglutination - RA
9. Agglutination-HCG
10. Agglutination-CRP
11. Flocculation – RPR
12. WIDAL - Slide method.
13. WIDAL - Tube method.
14. Precipitation Reaction – Immunodiffusion - Ouchterlony patterns.
15. Precipitation Reaction – Immunodiffusion – SRID
16. Immunoelectrophoresis –Double Immunodiffusion

17. Serum Immuno-electrophoresis
18. Counter Immuno-electrophoresis
19. Coomb's test
20. ELISA – Demonstration.

### COURSE OUTCOME

CO No.	CO Statement
CO 1	Analyse the morphology and total count of blood cells by complete blood count test.
CO 2	Appraise and detect various diseases by agglutination and precipitation reactions.
CO 3	Confirm the presence of infection by WIDAL and ELISA tests

### MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	1	1	1
CO 2	3	2	3	1	1	1
CO 3	3	2	3	1	2	1
<b>Average</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1.3</b>	<b>1</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### QUESTION PAPER PATTERN:

**Time: 6 Hours (3 Hrs, Two days)**

**Max Marks: 60**

**Major practical : 25 marks**  
**Minor practical : 15 marks**

**Spotters (5 x 2) : 10 marks**  
**Record : 10 marks**

**SEMESTER – IV**  
**ALLIED PRACTICALS**  
**BIOINSTRUMENTATION, COMPUTERS AND BIOSTATISTICS**

**TOTAL HOURS: 60**  
**CREDITS: 2**

**COURSE CODE: MB18/4A/PR1**  
**LT P: 0-0-2**

**COURSE OBJECTIVES:**

1. Learn principle, working mechanism and handling of important laboratory equipment's.
2. Use statistical representation of data.
3. Imbibe knowledge on application of biostatistics and computers.

**COURSE CONTENT**

1. Preparation of buffer solutions-phosphate buffer, acetate buffer, tris buffer.  
Measurement and adjustment of pH for prepared media or solution.
2. Principle and working of Micropipette.
3. Principle & working of –
  - a. Colorimeter
  - b. UV-Spectrophotometer

4. Principle and Working of BOD Incubator
5. Separation of serum, plasma and bacterial culture using centrifuge
6. Separation of lipids/ amino acids/ sugars/ organic acids by paper/TLC Chromatography
7. To separate a mixture of compounds (plant pigments, dyes) by Column Chromatography.
8. Agarose Gel electrophoresis
9. ELISA Reader
10. Demonstration of PCR
11. Representation of statistical data by (a.) Histograms (b) Ogive curve (c) Pie diagrams.
12. Determination of Statistical Averages / Central Tendency.
  - (a). Arithmetic Mean (b) Median (c) Mode
13. Determination of measures of dispersion
  - (a) Mean Deviation (b) Standard Deviation (c) Standard error
14. Tests of significance – application of following;
  - (a) Chi Square test (b) t –test
15. Computer Operations – getting acquainted with different parts of Computer.
16. Creating Files, Folders and Directories.
17. Applications of Computer in Biology using MS – Office
  - (a) MS – Word (b) MS – Excel (c) Power Point
18. Creating an e- mail account. Sending and receiving mails.
19. An introduction to Internet, Search Engines, Websites.
20. Browsing and Downloading.

### **COURSE OUTCOME**

<b>CO No.</b>	<b>CO Statement</b>
CO 1	Acquire knowledge on working principle of laboratory instruments.
CO 2	Utilize measures of central tendency and dispersion to solve statistical problems.
CO3	Appreciate operation of computer and its application in research.

### **MAPPING OF CO WITH PSO**

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	1	1	1	1	3	1
CO 2	2	2	2	2	3	1
CO 3	2	2	2	2	3	1
Average	1.6	1.6	1.6	1.6	3	1

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**QUESTION PAPER PATTERN**

(Time-3hrs, One day)

**Max Marks-60**

**Major practical : 30 marks**

**Minor practical : 20 marks**

**Record : 10 marks**

**COURSE PROFILE- SEMESTER V**

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/WK	TOTAL HOURS	L-T-P	CA	SA	TOTAL
MB18/5C/BAC	Bacteriology	4	5	75	3-2-0	40	60	100

MB18/5C/SAM	Soil and Agricultural Microbiology	4	5	75	3-2-0	40	60	100
MB18/5C/MPL	Medical Parasitology	4	5	75	3-2-0	40	60	100
MB18/5E/FMB Or MB18/5E/FMT	Food Microbiology/ Food processing technology	5	4	60	3-1-0	40	60	100
MB18/5E/BIO Or MB18/5E/GEG	Biotechnology/ Genetic Engineering	5	5	75	3-2-0	40	60	100
Self-Study Paper	Forensic Science and Crime Investigation*	2						100
	<b>TOTAL CREDITS</b>	<b>22 + 2</b> <b>(For Advanced Learners)</b>						



## **SEMESTER V BACTERIOLOGY**

**TOTAL HOURS: 75  
CREDITS: 4**

**COURSE CODE: MB18/5C/BAC  
L T P: 3-2-0**

### **COURSE OBJECTIVES**

1. Impart basic knowledge in concepts of bacterial structure, classification and virulence factors contributing to pathogenicity.
2. Introduce cultivation, pathogenesis and clinical features of different bacteria affecting humans.
3. Train various techniques of sample collection, transport and processing for laboratory diagnosis of bacterial diseases.
4. Study several immunological and serological methods for identification of non- cultivable bacteria
5. Teach the various zoonotic infections, ways to tackle them and use biosafety precautions.

### **COURSE OUTLINE:**

#### **UNIT I:**

**15 hours**

General Bacteriology-Principles of bacterial Classification. Bacterial virulence factors in pathogenicity. Clinical bacteriology- Collection, transport and processing of clinical samples for bacterial identification.

#### **UNIT II:**

**20 hours**

Gram Positive Bacteria - Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis, prevention and control of infections caused by *Staphylococcus aureus*, *Streptococcus pyogenes*, *Corynebacterium diphtheriae*, *Mycobacterium tuberculosis* and *Mycobacterium leprae*.

#### **UNIT III:**

**20 hours**

Gram Negative Bacteria - Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis, prevention and control of infections caused by *Escherichia coli*, *Salmonella*, *Shigella*, *Vibrio cholerae*, *Pseudomonas aeruginosa*, *Haemophilus influenzae*, *Bordetella pertussis*, *Neisseria gonorrhoeae* and *Neisseria meningitidis*.

#### **UNIT IV:**

**10 hours**

Spiral Forms and Non-Cultivable Bacteria - Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis, prevention and control of infections caused by *Helicobacter pylori*, *Spirochaetes* – *Treponema pallidum*, *Leptospira*, *Borrelia*, *Mycoplasma pneumoniae*, *Rickettsiae*- *pox*, *typhus*, *Chlamydia trachomatis*.

## UNIT V:

10hours

Zoonotic Bacterial Infections – Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis, prevention and control of infections caused by *Bacillus*, *Yersinia*, *Brucella*.

### RECOMMENDED TEXT BOOKS

1. Ananthanarayanan, R, &Panicker, C.K.J. (2005). Textbook of Microbiology- Orient Longman.
2. Greenwood, D., Slack, R.B., & Peutherer, J.F. (2002) Medical Microbiology 14<sup>th</sup>edn. Churchill Livingston London.
3. Medical Microbiology. (2008) MIMS. 5<sup>th</sup>edn Elsevier Ltd.

### REFERENCE BOOKS

1. Topley and Wilson's, (1990), Principles of Bacteriology, Edward Arnold, 8<sup>th</sup>edn. London.
2. Topley and Wilson's. (1997), Bacterial Infections. 9<sup>th</sup> edn. Edward Arnold, London.
3. Jawetz, E., Melnic, J.L. and Adelberg, E.A. (2000), Review of Medical Microbiology, 19<sup>th</sup> edn. Lange Medical Publications, U.S.A.
4. Williams and Wilkins, Holt. (1994), Bergey's Manual of Determinative Bacteriology, 9<sup>th</sup>edn. Baltimore, USA.
5. Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996), Mackie and McCartney Practical Medical Microbiology, 14<sup>th</sup>edn. Churchill Livingstone, London.

### JOURNALS

1. Indian Journal of Medical Microbiology
2. Journal of Bacteriology

### E-LEARNING RESOURCES

1. [https://bio.libretexts.org/Bookshelves/Microbiology/Book%3AMicrobiology\\_\(OpenStax\)/15%3AA\\_Microbial\\_Mechanisms\\_of\\_Pathogenicity/15.3%3AVirulence\\_Factors](https://bio.libretexts.org/Bookshelves/Microbiology/Book%3AMicrobiology_(OpenStax)/15%3AA_Microbial_Mechanisms_of_Pathogenicity/15.3%3AVirulence_Factors)
2. [https://www.healthcare.uiowa.edu/path\\_handbook/Appendix/Micro/micro\\_spec\\_collection.html](https://www.healthcare.uiowa.edu/path_handbook/Appendix/Micro/micro_spec_collection.html)
3. <http://www.textbookofbacteriology.net/>.
4. <https://www.msdmanuals.com/en-in/home/infections/bacterial-infections-gram-negative-bacteria/overview-of-gram-negative-bacteria>
5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4196475/>

### COURSE OUTCOME

CO No.	CO Statement
CO 1	Analyse the structure and factors contributing to pathogenicity of bacteria and acquire the skills of sample collection and processing for precise bacterial

	identification.
CO 2	Identify the appropriate cultivation and diagnostic techniques of Gram positive bacterial diseases and preventing them through immuno and chemoprophylaxis.
CO 3	Isolate and diagnose Gram negative bacteria of human importance affecting different organ systems with the therapeutic interventions to contain them.
CO4	Assess the role of spiral and non-cultivable bacteria in disease production and identifying them through modern molecular and immunological methods
CO 5	Devise appropriate control measures and biosafety precautions in tackling zoonotic infections

### MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	3	1	1
CO 2	3	2	3	2	2	2
CO 3	2	3	3	2	2	2
CO 4	2	3	3	3	2	2
CO 5	1	3	3	3	2	2
<b>Average</b>	<b>2.2</b>	<b>2.6</b>	<b>3</b>	<b>2.6</b>	<b>1.8</b>	<b>1.8</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total

<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER V  
SOIL AND AGRICULTURAL MICROBIOLOGY**

**TOTAL HOURS: 75**  
**CREDITS:5**

**COURSE CODE: MB18/5C/SAM**  
**L T P: 3-2-0**

**COURSE OBJECTIVES**

1. Demonstrate the role and contribution of microorganisms in soil.
2. Discuss the benefits resulting from interactions of soil microbes.
3. Explain the nutrient cycling of major and minor nutrients.

4. Outline the process of plant pathogenesis.
5. Assess the use of microbes as biofertilizers and bio pesticides.

### **COURSE OUTLINE:**

#### **UNIT I:**

**10 Hours**

Soil Microbiology – Physical and Chemical Properties of Soil. Soil Profile and Structure. Diversity and Distribution of Microbes in Soil - Bacteria, Actinomycetes, Algae, Fungi and Viruses.

#### **UNIT II:**

**20 Hours**

Microbial Interactions - Mutualism, Commensalism, Amensalism, Synergism, Competition, Parasitism. Rhizosphere, Phyllosphere, Mycorrhizae

#### **UNIT III:**

**10Hours**

Biogeochemical Cycles - Carbon Cycle, Nitrogen Cycle - Fixation of Molecular Nitrogen, Nitrification and Denitrification, Sulphur Cycle and Phosphorus Cycle.

#### **UNIT IV:**

**20 Hours**

Plant Pathology - Microbial Diseases of Plant-Bacterial - Citrus Canker, Soft Rot in Carrot, Bacterial blight of paddy Fungal – Red Rot of Sugar Cane, Tikka Disease of Groundnut, Fusarial Wilt in Cotton, Leaf rust of coffee. Viral - Mosaic Disease in Tobacco. Parasite- root knot nematode in tomato. Prevention and Control of Plant Diseases.

#### **UNIT V:**

**15 Hours**

Soil fertility - Definition and Soil Requirement for Agriculture. Production, Application and Uses of Biofertilizers - VAM, Rhizobium, Azotobacter, Azospirillum and Cyanobacteria. Biopesticides-Bacterial, Fungal and Viral.

### **RECOMMENDED TEXTBOOKS**

1. SubbaRao.N.S. (2005) Soil microorganisms and Plant Growth. 4<sup>th</sup> edn. Oxford and IBH Publishing Pvt Ltd
2. Atlas, R.M., and Bartha, R. (1998), Microbial Ecology Fundamentals and Applications, 3<sup>rd</sup> edn. Benjamin Cummings. Redwood City. C. A.
3. **Rangasamy. G and A. Mahadevan (1998). Diseases of Crop Plants in India. 4<sup>th</sup> edn. Prentice Hall India Learning Private Limited.**

### **REFERENCE BOOKS**

- 1.Subbarao.N.S.(1995), Biofertilizers in Agriculture and Forestry, 3<sup>rd</sup> edn. Oxford and IBH Publishing co. Pvt Ltd.
2. Paul, E.A. and Clark, F.E, (1996), Soil Microbiology and Biochemistry. 2<sup>nd</sup> edn. Academic Press, London.
3. Alexander, M, (1991), Introduction to Soil Microbiology. 2<sup>nd</sup> edn. Krieger Pub Co.
4. Mehrotra RS and Aggarwal A. (2017) Plant Pathology 3<sup>rd</sup> edn. McGraw Hill Education.

5. Agrios, G.N, (2004), Plant Pathology, 2<sup>nd</sup> edn Press, New York.

## JOURNALS

1. Indian Journal of Agricultural Research
2. Journal of Plant Pathology and Microbiology

## E-LEARNING RESOURCES

1. <http://www.futuredirections.org.au/publication/living-soils-role-microorganisms-soil-health/>
2. <http://www.discoverbiotech.com/wiki/wiki/Main/Soil+microorganisms+and+their+interactions>
3. <https://openoregon.pressbooks.pub/envirobiology/chapter/3-2-biogeochemical-cycles/>
4. <https://aem.asm.org/content/82/13/3698>
5. <http://www.biologydiscussion.com/plants/bacterial-diseases-in-plants-with-control-measures/24114>

## COURSE OUTCOME

CO No.	CO Statement
CO 1	Perceive the contribution and activity of soil microbes in enhancing soil fertility.
CO 2	Critically analyse the beneficial effects resulting from microbial interactions in soil.
CO 3	Appraise the crucial events involved in microbe-mediated transformation of elements in the ecosystem.
CO 4	Examine the mode of survival of pathogens on plants and assess its impact on crop production.
CO 5	Accredit the economic usage of beneficial soil microbes for better plant growth and yield.

## MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	2	3	1	1
CO 2	3	3	1	2	1	1
CO 3	3	3	2	3	1	2

<b>CO 4</b>	3	1	1	3	1	2
<b>CO 5</b>	3	3	2	3	2	2
<b>Average</b>	<b>3</b>	<b>2.6</b>	<b>1.6</b>	<b>2.8</b>	<b>1.2</b>	<b>1.6</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**TEACHING METHODOLOGY:**

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

**QUESTION PAPER PATTERN**

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER V  
MEDICAL PARASITOLOGY**

**TOTAL HOURS: 75  
CREDITS: 4**

**COURSE CODE: MB18/5C/MPL  
L T P: 3-2-0**

**COURSE OBJECTIVES:**

1. Impart knowledge in collection, transport, diagnosing techniques and cultivation of parasites.
2. Perceive the importance of protozoa in the intestine.
3. Evaluate the role of blood and tissue protozoans.
4. Summarize the general characters of trematodes and cestodes and their significance in causing infections.
5. Explain the importance of Nematodes as infectious agent.

**COURSE CONTENT:**

**UNIT I:**

**20 Hours**

Introduction to Medical Parasitology. Classification of Protozoa. Collection, Transport and Processing of Specimen. Examination of parasitic ova/ cyst by direct wet mount and iodine wet mount. Concentration techniques- Saturated salt solution, Zinc sulphate and Formol Ether method. Blood smear preparation- thick and thin. Cultivation of Parasites.

**UNIT II:**

**10 Hours**

Lifecycle, Pathogenesis, Lab diagnosis and Control of intestinal Protozoans – *Entamoeba* and *Balantidium*, Genito-Urinal Protozoans - *Giardia* and *Trichomonas*.



**UNIT III:****20 Hours**

Protozoology - Lifecycle, Pathogenesis, Lab diagnosis and Control of Blood and Tissue Protozoans - *Plasmodium*, *Leishmania*, *Trypanosoma* and *Toxoplasma*.

**UNIT IV:****10 Hours**

Helminthology - Platyhelminthes - General characters of Cestodes - Lifecycle, Clinical features, Lab diagnosis and Control of *Taenia*, *Echinococcus*. General characters of Trematodes – *Fasciola*, *Schistosoma paragonimus*.

**UNIT V:****15Hours**

Nemathelminthes - General characters of Nematodes - Lifecycle, Clinical features, Lab diagnosis and Control of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Trichinella spiralis*, *Enterobius vermicularis*, *Wuchereria bancrofti* and *Dracunculus medinensis*.

**RECOMMENDED TEXT BOOKS**

- 1.Chatterjee (2009). Medical Parasitology. 13<sup>th</sup> edition, CBS Publishers, New Delhi.
- 2.Arora.D.R. and Arora.B.B (2014),Medical Parasitology. 5<sup>st</sup> edition, CBS Publishers, New Delhi.
3. Parija S. C. (1996). Text Book of Medical Parasitology.4<sup>th</sup> edition, Orient Longman, All India Publishers & Distributors.

**REFERENCE BOOKS**

1. Garcia L.S (2016), Diagnostic Medical Parasitology, 6<sup>th</sup> edition, ASM Press.
2. Levanthal R. and Cheadle R.S. (2012), Medical Parasitology, 6<sup>th</sup> edition, S.A.Davies Co., Philadelphia.
3. Beck W. J. and Davies, J.E. (1976), Medical Parasitology, 2<sup>nd</sup> edition, C.V.Mosby Company, St. Louis.
4. Schmidt G.D and Roberts L.S. (1995), Foundations of Parasitology, 4<sup>th</sup> edition. Mosby, St. Louis.
5. Choidini.P.L, Moody.A.H and Manser D.W (2001) Atlas of Medical Helminthology and Parasitology, 4<sup>th</sup> edition,Churchill living stone.

**JOURNALS**

1. International Journal of Parasitology
2. Systematic Parasitology

**E-LEARNING RESOURCES**

1. <https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0006297>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2708390/>

3. <https://cmr.asm.org/content/31/1/e00025-17>
4. <https://cmr.asm.org/content/30/3/811>
5. <https://www.nejm.org/doi/full/10.1056/NEJMoa1811400>

**COURSE OUTCOME:**

<b>CO Number</b>	<b>CO STATEMENT</b>
CO 1	Obtain theoretical understanding in sample collection and diagnosis.
CO 2	Analyse the intestinal protozoan infections in human beings and apply techniques for identification and isolation of organisms and in treatment.
CO 3	Emphasize the importance of blood and tissue protozoans as infectious agents.
CO 4	Recognize the significance of cestodes and trematodes as infectious agents and detection of methods in diagnosing the disease and remedy in treating the infections.
CO 5	Apply in depth knowledge on Nematodes and their importance as pathogens.

**MAPPING OF CO WITH PSO**

<b>CO/PSO</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>	<b>PSO 5</b>	<b>PSO 6</b>
<b>CO1</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>
<b>CO2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>
<b>CO3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>
<b>CO4</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>
<b>CO5</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>
<b>Average</b>	<b>2.2</b>	<b>2.8</b>	<b>2.6</b>	<b>2.6</b>	<b>1.6</b>	<b>2.0</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**TEACHING METHODOLOGY:**

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER V**  
**FOOD MICROBIOLOGY**

**TOTAL HOURS:60**  
**CREDITS: 5**

**COURSE CODE: MB18/5E/FMB**  
**L T P: 3-1-0**

**COURSE OBJECTIVES**

1. Examine the role of microbes in growth and spoilage of food and apply specific preservation techniques.
2. Assess contamination of various food products and identify food pathogens using microbiological and immunological techniques.
3. Detect food borne infections, food poisoning and prevent food related outbreaks.
4. Learn the food quality analysis techniques and production of fermented milk products.
5. Implement good hygiene practices, introduce food laws and recent trends in food industries.

**COURSE OUTLINE**

**UNIT I:**

**10 Hours**

Introduction to Food Microbiology – Scope of food microbiology. Factors (Extrinsic and Intrinsic) affecting Microbial Growth in food. Microorganisms in Food - Bacteria and Fungi. Principles of Preservation - Asepsis, High Temperature, Low Temperature, Drying, irradiation and Food Additives.

**UNIT II:**

**10 Hours**

Spoilage of Food: Fruits, Vegetables, Fresh meat, Processed meat, poultry, Fish and sea foods, Canned foods. Culture, Microscopic, and Sampling Method for detecting microbes, Physical, Chemical methods, Immunological methods.

**UNIT III:**

**15 Hours**

Food Borne Infections and Food Poisoning - Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Nematodes, Protozoa, Algae, Fungi and Viruses. Food borne outbreaks in India.

**UNIT IV:**

**10 Hours**

Microbiology of Milk-Microbes in Milk, Milk borne Infections. Fermentation of Milk-Souring, Lactic Acid Fermentation, Colour and flavours, Gassy fermentation and proteolysis. Quality Control Tests – Phosphatase, Resazurin and Reductase Tests. Microbiology of Fermented Milk products -

Production of Cheese, Yogurt, Buttermilk, Kumis, Kefir, Acidophilus milk and Probiotics.

## UNIT V:

**15 Hours**

Good Hygiene Practices, Sanitation in manufacture and retail trade; Food control agencies and their regulations, Hazard analysis and critical control points (HACCP); GMP, Plant sanitation-employees' health standard, waste treatment, disposal, quality control. Bureau of Indian standards. Food laws and standards in India (FSS). Recent trends and development in food technologies in India.

### RECOMMENDED TEXT BOOKS:

1. Frazier, W.C., & West off, D.C. (1988). Food Microbiology, 4<sup>th</sup>edn. Tata McGraw Hill Publishing Company Ltd. New York
2. Jay, J.M. (2005). Modern Food Microbiology 4<sup>th</sup>edn, CBS Publishers and Distributors, New Delhi
3. Prescott and Dunn, (1982). Industrial Microbiology 4<sup>th</sup>edn, CBS Publishers and Distributors.

### REFERENCES:

1. Robinson R. K. (2000). Dairy Microbiology 3<sup>rd</sup>edn, Elsevier Applied Science, London.
2. Adams M.R, and Moss M.D, (2005). Food Microbiology 4<sup>th</sup> edn, New Age International Pvt. Ltd., Publishers.
3. Banwarst. G.J. (2003). Basic Food Microbiology 2<sup>nd</sup>edn, CBS Publishers and distributors.
4. Hobbs, B.C. and Roberts, D, (1968). Food Poisoning and Food Hygiene 7<sup>th</sup>edn. Edward Arnold: London.
5. Vijaya R K, (2004). Food Microbiology ,1<sup>st</sup> edn, MJP Publishers, Chennai.

### JOURNALS

1. **International Journal of Food Microbiology**
2. Indian Journal of Microbiology and Research

### E-LEARNING RESOURCES:

1. [https://www.researchgate.net/publication/15326559\\_A\\_Dynamic\\_Approach\\_to\\_Predicting\\_Bacterial-Growth\\_in\\_Food/link/5a1d2e02aca2726120b28eba/download](https://www.researchgate.net/publication/15326559_A_Dynamic_Approach_to_Predicting_Bacterial-Growth_in_Food/link/5a1d2e02aca2726120b28eba/download)
2. <https://www.fda.gov/food/laboratory-methods-food/bam-food-samplingpreparation-sample-homogenate>
3. [https://www.researchgate.net/publication/243462186\\_Foodborne\\_diseases\\_in\\_India\\_-\\_A\\_review](https://www.researchgate.net/publication/243462186_Foodborne_diseases_in_India_-_A_review)
4. [https://www.researchgate.net/publication/228662659\\_Fermented\\_Dairy\\_Products\\_Starter\\_Cultures\\_and\\_Potential\\_Nutritional\\_Benefits/link/000084160cf23f86393d5764/download](https://www.researchgate.net/publication/228662659_Fermented_Dairy_Products_Starter_Cultures_and_Potential_Nutritional_Benefits/link/000084160cf23f86393d5764/download)
5. <https://www.fda.gov/food>

### COURSE OUTCOMES

CO1	Determine the role of microorganisms in spoilage and food preservation techniques.
CO2	Analyse the contamination of foods, detect food pathogens based on physical, chemical and immunological methods and choose appropriate preservative techniques.

CO3	Examine and identify the role of pathogens in food borne infections and food poisoning and prevent food borne outbreaks.
CO4	Use quality control tests and apply the knowledge of fermented food products.
CO5	Implement SOP in food industries.

### MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO3	PSO4	PSO5	PSO6
<b>CO 1</b>	3	2	1	3	1	1
<b>CO 2</b>	1	2	3	3	2	2
<b>CO 3</b>	2	2	1	3	2	2
<b>CO 4</b>	2	2	2	3	2	2
<b>CO 5</b>	2	2	2	3	2	1
<b>Average</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>1.8</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	

<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	
--------------	--	------	-----------	--

**SEMESTER V**  
**FOOD PROCESSING TECHNOLOGY**

**TOTAL HOURS: 60**  
**CREDITS: 5**

**COURSE CODE: MB18/5E/FPT**  
**L T P: 3-1-0**

**COURSE OBJECTIVES**

- 1. Demonstrate the importance and techniques of food preservation.**
2. Obtain insights on quality assessment of meat and fish.

3. Acquire knowledge about fermented milk products.
4. Explain the food safety regulations.
5. Impart knowledge on Microbiological examination of foods.

## **COURSE OUTLINE:**

### **UNIT I**

**15 Hours**

Introduction to food preservation –objectives and techniques of food preservation. Preservation principles of high temperature, low temperature, radiation, chemical preservatives and biopreservatives.

### **UNIT II**

**15 Hours**

Freshness criteria and quality assessment of meat and fish –spoilage and methods of preservation technique. Production of by-products after processing waste and their utilization. Role of packaging material, types of packaging material.

### **UNIT III**

**15 Hours**

Composition of milk; assessment of milk, thermal processing of fluid milk-pasteurization (LTH, HTST &UHT techniques). Fermented milk products-cheese, Butter milk, yogurt, Kumis, Kefir and Acidophilus milk. Hygiene and sanitation requirement in food processing and fermentation industries.

### **UNIT IV**

**15 Hours**

Importance of fats and oils in Food-Extraction of fats and Oils-Rendering, pressing, solvent extraction, pressing of oil- degumming, refining, bleaching, deodorization, fractionation, pyrolysis of fats, toxicity of frying oil.

### **UNIT V**

**15 Hours**

Methods for the microbiological examination of foods. Food borne illness and diseases. Microbial cultures for food fermentation. Indian Factories Act on safety, HACCP, Safety from adulteration of food.

## **RECOMMENDED TEXT BOOKS:**

1. Frazier, W.C., &West off, D.C. (1988). Food Microbiology, 4<sup>th</sup>edn. Tata McGraw Hill Publishing Company Ltd. New York.
2. Jay J.M. (2005). Modern Food Microbiology 4<sup>th</sup>edn, CBS Publishers and Distributors., New Delhi.
3. Prescott and Dunn, (1982). Industrial Microbiology 4<sup>th</sup>edn, CBS Publishers and Distributors.

## **REFERENCES:**

1. Robinson R. K. (2000). Dairy Microbiology 3<sup>rd</sup>edn, Elsevier Applied Science, London.
2. Adams M.R, and Moss M.D, (2005). Food Microbiology4<sup>th</sup> edn, New Age International Pvt. Ltd., Publishers.



- Banwarst. G.J. (2003). Basic Food Microbiology 2<sup>nd</sup>edn, CBS Publishers and distributors.
- Hobbs, B.C. and Roberts, D, (1968). Food Poisoning and Food Hygiene 7<sup>th</sup>edn. Edward Arnold: London.
- Vijaya R K, (2004). Food Microbiology ,1<sup>st</sup>edn, MJP Publishers, Chennai.

## JOURNALS

- International Journal of Food Microbiology**
- Indian Journal of Microbiology and Research

## E-LEARNING RESOURCES:

- <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=17055>
- <https://www.fda.gov/food/laboratory-methods-food/bam-food-samplingpreparation-sample-homogenate>
- <https://dairyprocessinghandbook.com/chapter/fermented-milk-products>
- [http://tarek.kakhia.org/books\\_eng/ENCYCOPEDIA\\_OF\\_OILS\\_and\\_FATS.Tarek\\_Kakhi\\_a.pdf](http://tarek.kakhia.org/books_eng/ENCYCOPEDIA_OF_OILS_and_FATS.Tarek_Kakhi_a.pdf)
- <https://www.slideshare.net/Adrienna/overview-of-fss-act-rules-regulation2012>

## COURSE OUTCOME

CO1	Determine the role of microorganisms in food industries, preservation techniques, and spoilage of food.
CO2	Analyse the contamination of foods, detect food pathogens and importance of packaging material.
CO3	Assess the techniques in checking milk quality, fermentation of milk and to perform production of fermented milk foods on a large scale level.
CO4	Acquire skills on extraction and toxicity of oil from food.
CO5	Examine and identify the role of pathogens in food borne infections and food poisoning. Implement hygiene practice and sanitation. Food laws and standards for good quality in food production.

## MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO3	PSO4	PSO5	PSO6
<b>CO 1</b>	3	2	1	3	1	1
<b>CO 2</b>	1	2	3	3	2	2
<b>CO 3</b>	2	2	1	3	2	2

<b>CO 4</b>	2	2	2	3	2	2
<b>CO 5</b>	2	2	2	3	2	1
<b>Average</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>1.8</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**TEACHING METHODOLOGY:**

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

**QUESTION PAPER PATTERN**

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER V  
BIOTECHNOLOGY**

**TOTAL HOURS: 75  
CREDITS: 5**

**COURSE CODE: MB18/5E/BIO  
L T P: 3-2-0**

**COURSE OBJECTIVES:**

1. Outline History and social concerns of Biotechnology.
2. Learn plant tissue culture methods and use of Ti plasmid as vector.
3. Examine Animal cell cultures, cell lines and applications of Biotechnology in Human welfare.
4. Learn protocols and components involved in genetic engineering.
5. Acquire knowledge about molecular techniques and cloning vectors.

**COURSE OUTLINE:**

**UNIT-I**

**15 Hours**

Introduction- Historical and recent developments in Biotechnology- Immobilization of cells and enzymes and its applications. Social and ethical aspects of Biotechnology- Intellectual Property Rights (IPR) -Definition and types - Patents and trademarks.

**UNIT-II**

**15 Hours**

Plant biotechnology - media and equipment for plant tissue culture- explant culture- micropropagation-somatic hybridization, Ti plasmid – structure and strategies of gene transfer

using Ti plasmid in plants – cointegrate vector, binary vector and its applications. Transgenic plants - insect resistant plants - golden rice

### **UNIT-III**

**15 Hours**

Animal biotechnology- principles of animal cell culture, media and equipment for animal cell culture - primary and secondary cultures- Cell lines- types, establishment and maintenance of cell lines. Transgenic animals – mice and sheep. Production of insulin, interferons, factor VII- Human gene therapy- Germline and somatic cell therapy

### **UNIT IV**

**15 Hours**

History of rDNA technology- Steps involved in gene cloning. Isolation of bacterial, phage and plasmid DNA. Enzymes involved in genetic engineering - restriction endonucleases, ligases, reverse transcriptase, DNA polymerase- use of linkers and adapters.

### **UNIT V:**

**15 Hours**

Cloning vectors – structure, uses, methods of cloning and selection of recombinants using pBR 322, pUC, cosmids, lambda phage based vectors, shuttle vectors, YAC. Artificial methods of transformation- transfection. Molecular Techniques - southern blotting, northern blotting, western blotting, PCR, Microarray-DNA sequencing methods- Sanger's and automated methods.

### **RECOMMENDED TEXTBOOKS:**

1. Glick B.K. and Pasternak, J.J, (2015) Molecular Biotechnology. Principles and Applications of Recombinant DNA. 5<sup>th</sup> edn. ASM Press, Washington, DC.
2. Freifelder D, (2008). Molecular Biology. 2<sup>nd</sup> edn. Narosa Publishing house, New Delhi.
3. Crichton. M. (2014). Essentials of Biotechnology. 1<sup>st</sup> edn. Scientific international Pvt Ltd. New Delhi.

### **REFERENCE BOOKS:**

1. Brown, T.A. (2001). Gene Cloning and DNA Analysis – An Introduction, 4<sup>th</sup> edn, Blackwell. Science Ltd.Oxford.
2. Old R. W. and Primrose S. B., (1985), Principles of Gene Manipulation. 4<sup>th</sup> edn. Black well Scientific Publications, London.
3. Dubey and Maheshwari. (2007). A textbook of Biotechnology, Revised edn. S.Chand and company.
4. Lee Yuan Kun (2003). Microbial Biotechnology- Principles and Applications- 2<sup>nd</sup> Edition World Scientific.
5. V. Kumaresan. (2015). Biotechnology. Revised edn. Saras Publication.

### **JOURNALS:**

1. Indian Journal of Biotechnology.
2. Journal of Biotechnology.

### **E-LEARNING RESOURCES:**

1. <https://www.easybiologyclass.com/enzyme-cell-immobilization-techniques/amp/>
2. <https://www.microscopemaster.com/tissue-culture.html>

3. <https://www.nap.edu/read/10418/chapter/3>
4. <http://www.biologydiscussion.com/essay/enzymes-essay/role-of-enzymes-in-genetic-engineering-essay-genetic-engineering/84627>
5. [http://biology.kenyon.edu/courses/biol114/Chap08/Chapter\\_08a.html](http://biology.kenyon.edu/courses/biol114/Chap08/Chapter_08a.html).

**COURSE OUTCOME:**

CO 1	Demonstrate the historic milestones in Biotechnology, legal implications and ethics involved in Biotechnology Research.
CO 2	Explain Plant Tissue Culture protocols and gene transfer mechanism.
CO 3	Use Animal cell culture methods for maintenance of various cell lines.
CO 4	Examine cloning protocol in rDNA technology.
CO 5	Discuss the molecular methods and the various vectors used in them.

**MAPPING OF CO WITH PSO**

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2	3	3	2	1	3
CO2	1	3	3	3	1	2
CO3	1	3	3	3	1	2
CO4	2	3	3	3	2	2
CO5	1	3	3	3	2	2
<b>AVERAGE</b>	1.4	3	3	2.8	1.4	2.2

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**TEACHING METHODOLOGY:**

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

**QUESTION PAPER PATTERN**

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER V**  
**GENETIC ENGINEERING**

**TEACHING HOURS: 75**  
**CREDITS: 5**

**COURSE CODE: MB18/5E/GEG**  
**L T P: 4-2-0**

**COURSE OBJECTIVES:**

1. Outline the basic techniques in Gene cloning
2. Describe the methods of DNA transfer in bacteria, plants and animals.
3. Illustrate the molecular tools employed in Gene cloning
4. Explain the application of Genetic Engineering in Medicine
5. Assess the benefits of transgenics in Agriculture.

**COURSE OUTLINE**

**UNIT I**

**15 Hours**

Introduction to Genetic Engineering- History of rDNA technology. Methods of DNA isolation from bacteria animals and plants. Cutting and joining DNA molecules- Restriction enzymes, Restriction modification, Ligases, Use of Linkers and Adapters.

**UNIT II**

**15 Hours**

Vectors used in genetic engineering- Introduction to Cloning Vectors – Plasmids, Cosmids, Phage vectors, Phasmids, Artificial chromosomes BACs, YACs, PACs Expression Vectors, Plant vectors.

**UNIT III**

**15 Hours**

Steps involved in gene cloning in bacteria- methods of introduction of DNA- Methods of selection of recombinants- Gene transfer to animal cells- chemical, physical and viral mediated transfer- Gene transfer to plant cells- *Agrobacterium* mediated transfer and plant viruses- CaMV.

**UNIT IV**

**15 Hours**

Molecular tools- PCR- Quantitative Real Time PCR -- Gel Electrophoresis- AGE & PAGE -- Blotting Techniques: Southern, Western & Northern, DNA sequencing methods- Sanger's and Automated method.

**UNIT V**

**15 Hours**

Applications of genetic engineering in medicine and agriculture- gene therapy, transgenic plants. Recent trends in genetic engineering- Targeted Genome Editing: ZFNs, TALENs, CRISPRs -- Gene Targeting: Knock-ins & Knock-outs -- DNA Finger Printing, Bioethics.

## RECOMMENDED TEXT BOOKS

1. Brown, T.A. (2001). Gene Cloning and DNA Analysis – An Introduction, 4<sup>th</sup> edn, Blackwell. Science Ltd.Oxford.
2. Russell P.J, (2010). Genetics-a molecular approach 3<sup>rd</sup> edn, Benjamin Cummings.
3. Glick B.K. and Pasternak, J.J, (2015) Molecular Biotechnology. Principles and Applications of Recombinant DNA. 5<sup>th</sup> edn. ASM Press, Washington, DC.

## REFERENCE BOOKS

1. Desmond S.T. Nicholl. (1994). An Introduction to Genetic Engineering. Cambridge Press.
2. Watson, J. D., Gilman, M., Witkowseski,J., (1992). Recombinant DNA, 2<sup>nd</sup> edn, Scientific Books.
3. Old R. W. and Primrose S. B. (1989). Principles of Gene Manipulation. 4<sup>th</sup> edn. Black well Scientific Publications, London.
4. Freifelder D, (2008). Molecular Biology. 2<sup>nd</sup> edn. Narosa Publishing house, New Delhi.
5. V. Kumaresan.(2015). Biotechnology. Revised edn. Saras Publication.

## JOURNALS:

1. Indian Journal of Biotechnology
2. Indian journal of Experimental Biology

## E-LEARNING RESOURCES:

1. <https://www.sciencedirect.com/science/article/pii/S0734975018302064>
2. [https://s3-us-west-2.amazonaws.com/oww-files-public/6/6d/Molecular\\_Techniques.pdf](https://s3-us-west-2.amazonaws.com/oww-files-public/6/6d/Molecular_Techniques.pdf)
3. <https://www.neb.com/tools-and-resources/feature-articles/crispr-cas9-and-targeted-genome-editing-a-new-era-in-molecular-biology>
4. <https://www.sciencedirect.com/science/article/pii/S0974694313003289>
5. [https://www.researchgate.net/publication/263714372\\_Transgenic\\_Plants](https://www.researchgate.net/publication/263714372_Transgenic_Plants)

## COURSE OUTCOME

CO No.	CO Statement
CO 1	Elucidate the methods of DNA isolation and understand the concepts of restriction and ligation of DNA.
CO 2	Critically analyse the structure and employment of cloning vectors in gene cloning experiments.
CO 3	Illustrate the steps involved in introduction of DNA into bacteria, animal and plants cells and their screening.



CO 4	Assess the usage and advantages of molecular tools employed in gene cloning.
CO 5	Analyse the application of gene cloning in medicine and agriculture.

### MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	1	2	1	3	1	1
CO 2	1	3	1	1	1	1
CO 3	1	3	1	3	1	1
CO 4	1	3	2	1	1	1
CO 5	1	3	3	3	1	2
<b>Average</b>	<b>1</b>	<b>2.8</b>	<b>1.6</b>	<b>2.2</b>	<b>1.0</b>	<b>1.2</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K 1	A-10x2marks (Compulsory)	One or Two Sentences	20	100
K1, K2	B-5x8 marks  (8 questions will be given)	500	40	

	covering all Five Units)			
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER - V**  
**SELF-STUDY PAPER**  
**FORENSIC SCIENCE AND CRIME INVESTIGATION**

**COURSE CODE:**

**CREDITS: 2**

**COURSE OBJECTIVES**

- 1.Introduce basics of Forensic Science.
- 2.Understand crime and its causes.
- 3.Emphasize on crime scene investigation methods.

4. Learn about Forensic toxicology.
5. Explain the emerging trends in forensic science.

## **COURSE CONTENT:**

### **UNIT I:**

Forensic science- Definition, scope, purpose and branches. Organization set up of Forensic Science Laboratory: Structure and function of State and Central Forensic Science Laboratory and facilities provided. Directorate of Forensic Science Service.

### **UNIT II:**

Crime-Definition, types, causes and prevention. Difference between Blue and white collar crimes. Introduction to cybercrime, criminal behaviour, criminal profiling and criminal justice system- Police, Medico-legal expert, judicial officers.

### **UNIT III:**

Crime Scene Investigation-Role of investigator, evaluation, search pattern and protection of a crime scene. Photography and sketching of crime scene. Documentation in crime scene- collection, packaging, labelling and forwarding of exhibits to forensic laboratories. Preservation of evidence, health and safety protocols.

### **UNIT IV:**

Forensic investigation of crime scene evidences- Viscera, blood, semen, hair, saliva, vomit and other biological samples. Analytical Techniques-Finger/foot prints, DNA analysis, Anthropology- skeletal remains. Document Examination-Voice Pattern Analysis and Forensic ballistics.

### **UNIT V:**

Forensic toxicology and medicine-types and mode of action of poisons. Medico-legal autopsy demonstration and interpretation. Case Studies. Emerging trends in Forensic science. Ethical issue in Forensic Science, professional standards for practice of Criminalistics.

## **RECOMMENDED TEXT BOOKS:**

1. B.B. Nanda and R.K. Tiwari (2001). Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi.
2. W.J. Tilstone, M.L. Hastrup and C. Hald (2013). Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton.
3. S.H. James and J.J. Nordby (2005). Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton.

## **REFERENCES:**

1. B.B. Nanda and R.K. Tiwari (2001). Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi.
2. W.G. Eckert and R.K. Wright (1997). Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED), CRC Press, Boca Raton.

3. R. Saferstein (2004). Criminalistics, 8<sup>th</sup> Edition, Prentice Hall, New Jersey.
4. T.J. Gardener and T.M. Anderson (2001). Criminal Evidence, 4<sup>th</sup> Ed. Wadsworth, Belmont.
5. B.J. Heard (1997). Handbook of Firearms and Ballistics, Willy and Sons, Chichester.

**JOURNALS:**

1. Journal of Forensic Science and Criminology.
2. Journal of Forensic research.

**E-LEARNING RESOURCES**

1. <https://www.pinow.com/investigations/forensic-investigations>.
2. <https://www.atascientific.com.au/technologies-forensic-sciences/>
3. <http://what-when-how.com/police-science/crime-scene-search-and-evidence-collection-police/>
4. <https://nij.ojp.gov/topics/articles/dna-evidence-basics-identifying-gathering-and-transporting>
5. <https://jguforensics.wordpress.com/2017/04/18/ethics-in-forensic-science/>

**COURSE OUTCOME**

CO No.	CO Statement
CO 1	Familiarize oneself with developments and organizations in forensic science.
CO 2	Acquire knowledge on types of Crime and its causes as well prevention.
CO 3	List the services performed by a Crime investigator, Crime laboratories and Medical examiners.
CO 4	Analyse the role of a forensic scientist in Crime scene investigations.
CO 5	Gather information on Forensic toxicology and ethics in Forensic science.

**QUESTION PAPER PATTERN (Internal Exam and Valuation)**

Knowledge Level	Section	Word Limit	Marks	Total
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	

<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	
--------------	---	------	-----------	--

### COURSE PROFILE- SEMESTER VI

<b>COURSE CODE</b>	<b>TITLE OF THE PAPER</b>	<b>CREDITS</b>	<b>HOURS/ WK</b>	<b>TOTAL HOURS</b>	<b>L-T-P</b>	<b>CA</b>	<b>SA</b>	<b>TOTAL</b>
MB18/6C/MML	Medical Mycology	4	6	90	4-2-0	40	60	100
MB18/6C/ENM	Environmental Microbiology	4	6	90	4-2-0	40	60	100
MB18/6C/VIR	Virology	4	6	90	4-2-0	40	60	100
MB18/6E/INM Or MB18/6E/MFT	Industrial Microbiology/  Microbial Fermentation technology	5	6	90	4-2-0	40	60	100
MB18/6C/PR3	Medical Microbiology	4	3	90	0-0-3	40	60	100
MB18/6C/PR4	Applied Microbiology	4	3	90	0-0-3	40	60	100
	<b>TOTAL CREDITS</b>	<b>25</b>						

--	--	--	--	--	--	--	--	--

**SEMESTER VI  
MEDICAL MYCOLOGY**

**TOTAL HOURS: 90  
CREDITS: 4**

**COURSE CODE: MB18/6C/MML  
L T P: 4-2- 0**

**COURSE OBJECTIVES:**

1. Analyze the concepts of taxonomy and classification of fungi.
2. Investigate the medical importance of superficial and subcutaneous mycoses.
3. Summarize the biological mechanisms affecting the entire human system by systemic Mycoses.
4. Reveal the importance of opportunistic infections caused by fungi.
5. Interpret the skills on diagnostic techniques in mycotic infections.

**COURSE OUTLINE:**

**UNIT I:**

**15 Hours**

General Mycology - morphology, taxonomy and classification of medically important Fungi- Mycotoxins and antifungal agents-cultivation of fungi.

**UNIT II:****20 Hours**

Superficial Mycoses - Pathogenesis, laboratory diagnosis and treatment of *Pityriasis versicolor*, *Tinea nigra*, *Piedra* and dermatophytoses. Subcutaneous mycoses - pathogenesis, laboratory diagnosis and treatment of mycetoma and sporotrichosis.

**UNIT III:****20 Hours**

Systemic Mycoses - Pathogenesis, Laboratory diagnosis and Treatment of *Histoplasmosis*, Blastomycosis, Coccidioidomycosis and Paracoccidioidomycosis.

**UNIT IV:****20 Hours**

Opportunistic Mycoses - Pathogenesis, Laboratory diagnosis and Treatment of Cryptococcosis, Candidiasis, Aspergillosis and Zygomycosis.

**UNIT V:****15 Hours**

Clinical Mycology - Collection, transport and storage of fungal specimens. Recent diagnostic techniques in mycological infections.

**RECOMMENDED TEXT BOOKS:**

1. Chander, J. (2009). A Text book of Medical Mycology, 4<sup>th</sup>edn, Jaypee Brothers Medical Publishers (P)Ltd.
2. Arora.D.R. and Arora.B.B (2014).Medical Mycology, 4<sup>th</sup> edn, CBS Publishers, New Delhi.
3. RS Mehrotra and K R Aneja (1990). An Introduction to Mycology,2<sup>nd</sup> edn, New age International Publishers, New Delhi.

**REFERENCE BOOKS:**

- 1.Alexopolus, C.J. and Mims, C.W. (1995). Introductory Mycology, 4<sup>th</sup>edn, John Wiley and Sons, New York.
2. Fisher, F. and Cook, N.B. (1998). Fundamentals of Diagnostic Mycology,1<sup>st</sup> edn, W.B. Saunders Company, Pennsylvania.
- 3.Davise H. Larone, (2002). Medically Important Fungi: A Guide to Identification, 4<sup>th</sup>edn, American Society for Microbiology.
4. Brooks G. F, Jawetz E, Melnick J and Adelberg E. (2016). Medical Microbiology, 27<sup>th</sup> edn, MC Graw Hill.
- 5.Reiss E, Shadomy J.H, Lyon M.G (2011),1<sup>st</sup>edn, Fundamental Medical Mycology, Wiley-Blackwell.

**JOURNALS:**

1. Medical Mycology
2. Studies in Mycology

**E-LEARNING RESOURCES:**

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4047123/>

2. <https://www.ncbi.nlm.nih.gov/pubmed/21722309>
3. <https://www.sciencedirect.com/science/article/pii/S2211753919300193>
4. [https://www.unboundmedicine.com/medline/citation/31436337/Internal\\_environment\\_of\\_footwear\\_is\\_a\\_risk\\_factor\\_for\\_tinea\\_pedis](https://www.unboundmedicine.com/medline/citation/31436337/Internal_environment_of_footwear_is_a_risk_factor_for_tinea_pedis).
5. <https://academic.oup.com/cid/article/51/5/561/333903>

### COURSE OUTCOME:

CO Number	CO STATEMENT
CO 1	Explain classification of medically important fungi.
CO 2	Examine the significance of fungi affecting superficial and subcutaneous tissues.
CO 3	Analyse the role of systemic mycoses in clinical disease and perceiving the knowledge in diagnosing and treating infections.
CO 4	Evaluate the importance of opportunistic fungi and the methods to combat their infections by diagnosis and treatment.
CO 5	Apply diagnostic methods in mycotic infections.

### MAPPING OF CO WITH PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	1	1	1	1
CO2	2	2	2	3	1	2
CO3	2	2	2	3	2	2
CO4	2	2	2	3	2	2
CO5	1	2	3	2	2	2
Average	2	2	2	2.4	1.6	1.8

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**



**TEACHING METHODOLOGY:**

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

**QUESTION PAPER PATTERN**

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER VI  
ENVIRONMENTAL MICROBIOLOGY**

**TOTAL HOURS: 90  
CREDITS:4**

**COURSE CODE: MB18/6C/ENM  
L T P: 4-2-0**

**COURSE OBJECTIVES**

1. Assess the presence and versatility of air microflora.
2. Analyse the importance of microbes in sewage treatment and water quality.
3. Explain the role of microbes in biofuel production and bioleaching.
4. Demonstrate the essential role of microbes in biodegradation and bioremediation of contaminated environments.
5. Illustrate the function of microbes in biodeterioration and oil recovery.

**COURSE OUTLINE:**

**UNIT I:**

**20 Hours**

Microbiology of Air - Introduction to Atmospheric Layers, Sources of Microorganism, Air Micro Flora -Indoor and Outdoor Air. Factors affecting Air Micro-flora, Enumeration of Microbes in Air- Air sanitation- Air Borne Diseases

**UNIT II:**

**20 Hours**

Microbiology of Water - Introduction, Natural waters, Distribution of Microorganisms in the Aquatic Environment, Sources and Types of Water Pollution, Biological Indicators of Water Pollution. Determination of the quality of Water - MPN Index, Membrane Filtration, Biological Oxygen Demand. Water Purification in Municipal Water Supply, Parameters of Potable Water, Water Borne Diseases.

**UNIT III:**

**20 Hours**

Microbiology of Sewage- BOD- Waste Water Treatment - Primary - Secondary - Tertiary Treatment -Disposal of Solid Wastes – Composting and Landfill.

**UNIT IV:**

**20 Hours**

Biofuel Production – Ethanol, Methane and Hydrogen. Biodegradation – Lignin. Xenobiotics – halocarbons, PCB and Synthetic polymers. Microbial Leaching of ores.

**UNIT V:**

**10 Hours**

Biodeterioration of Paper, Leather and Wood. Microbial enhanced Oil recovery. Vermicomposting – Pit and windrow method

**RECOMMENDED TEXT BOOKS:**

1. Atlas R. M and Bartha R. (1998). Microbial Ecology Fundamentals and Applications 3<sup>rd</sup> edn. Benjamin Cummings. Redwood City .CA
2. Daniel. C.J., (1999). Environmental aspects of Microbiology, 1<sup>st</sup> edn. Bright Sun Publications
3. Vijaya R K, (2004). Environmental Microbiology. 1<sup>st</sup>edn MJP Publishers, Chennai.

**REFERENCES:**

1. Rheinheimer. G, (2007). Aquatic Microbiology. 2<sup>nd</sup> edn. John Wiley and Son, London.
2. Buckley RG. (2016) Environmental Microbiology 1<sup>st</sup> edn. CBS Publishing.
3. Maier RM, Pepper IL, Gerba CP (2008). Environmental Microbiology, 2<sup>nd</sup> Academic Press
4. Scragg, A, (2007). Environmental Biotechnology. 2<sup>nd</sup> Oxford., England.
5. Allsopp D, Seal KJ, Gaylarde CC. (2004) Introduction to Biodeterioration. 2<sup>nd</sup> edn. Cambridge University Press.

**JOURNALS:**

1. Indian Journal of Environmental Protection
2. Journal of Environmental Sciences

**E-LEARNING RESOURCES:**

1. <https://www.healthline.com/health/airborne-diseases#prevention>
2. [https://www.researchgate.net/publication/322759519\\_Microbes\\_as\\_Indicators\\_of\\_Water\\_Quality\\_and\\_Bioremediation\\_of\\_Polluted\\_WatersA\\_Novel\\_Approach](https://www.researchgate.net/publication/322759519_Microbes_as_Indicators_of_Water_Quality_and_Bioremediation_of_Polluted_WatersA_Novel_Approach)
3. <http://www.fao.org/3/t0551e/t0551e05.htm>
4. [https://unctad.org/en/Docs/ditcted200710\\_en.pdf](https://unctad.org/en/Docs/ditcted200710_en.pdf)
5. <http://www.biologydiscussion.com/environmental-microbiology/biodeterioration-of-various-materials-microbiology/66809>

**COURSE OUTCOME**

CO No.	CO Statement
CO 1	Illustrate the distribution of air microflora and their impact on air quality.
CO 2	Identify the diverse microflora of water and assess their significance in water treatment, water pollution and water quality.

CO 3	Appraise the microbial processes involved in the treatment of sewage and solid wastes.
CO 4	Assess the utility of microbes in biofuel production, biodegradation and bioleaching of ores.
CO 5	Examine the microbial deterioration of natural products.

### MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	1	1	1	2	1
CO 2	3	3	1	1	1	1
CO 3	3	3	1	1	1	2
CO 4	1	3	3	3	3	2
CO 5	3	3	2	3	1	2
<b>Average</b>	<b>2.6</b>	<b>2.6</b>	<b>1.6</b>	<b>1.8</b>	<b>1.6</b>	<b>1.6</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks (8 questions will be given)</b>	500	<b>40</b>	

	covering all Five Units)			
<b>K3,K4</b>	<b>C-2 x20 marks</b> (4 questions covering any Four units will be given)	1200	<b>40</b>	

## SEMESTER VI

### VIROLOGY

**TOTAL HOURS: 90**  
**CREDITS: 4**

**COURSE CODE: MB18/6C/VIR**  
**L T P: 3-1-0**

#### **COURSE OBJECTIVES:**

1. Provide an understanding of virus architecture and replication strategies.
2. Elucidate pathogenesis of diseases caused by viruses.
3. Gain wider knowledge on clinical aspects and related implications of viral diseases.
4. Describe the oncogenic virus infections and emerging viral infections.
5. Acquire knowledge on viral vaccines and antiviral drugs.

#### **COURSE OUTLINE:**

##### **UNIT I**

**10 Hours**

History and principles of virology, virus taxonomy, introduction to virus replication strategies. Structure, morphology and general properties of viruses. Cultivation of viruses – inoculation in animals, embryonated eggs and tissue culture.

##### **UNIT II**

**20 Hours**

DNA viruses - Structure, replication, pathogenesis, diagnosis and treatment of Pox virus (Small pox and Molluscum contagiosum), Herpes Virus (Varicella, HSV, Cytomegalovirus, Epstein Barr Virus) Human Hepatitis B virus and Adenovirus.

##### **UNIT III**

**20 Hours**

RNA viruses - Structure, replication, pathogenesis, diagnosis and treatment of Picorna Virus- Polio Virus, Rhabdovirus- Rabies, Orthomyxovirus- Influenza virus, Paramyxovirus- Mumps and Measles, Corona- SARS virus. Retro Virus- Human Immunodeficiency virus. Hepatitis virus- HAV and HCV

##### **UNIT IV**

**20 Hours**

Arthropod borne virus- dengue, chikungunya and Mosquito borne encephalitis. Oncogenic Viruses- Human papilloma virus, HCV and Herpes viruses. Virioids, Virusoids and Prions.

##### **UNIT V**

**20 Hours**

Clinical Virology - Collection, handling and processing of specimens for detection by Immunohistochemistry, electron microscopy, serological and molecular method- introduction to Reverse transcriptase analysers for mutagenic viruses- PCR. Viral vaccines, Interferons and antiviral drugs.

#### **RECOMMENDED TEXTBOOKS:**

1. Jawetz, E., Melnick, J.L. and Adelberg, E.A., (1991), Review of Medical Microbiology 19<sup>th</sup>edn. Lange Medical Publications, USA.

- Luria, S.E., Darnel, J.E., Jr., Baltimore, D. and Campbell. A, (1978), General Virology, 3<sup>rd</sup>edn. John Wiley & Sons, New York.
- Greenwood, D., Slack, R.B., and Peutherer, J.F (1993). Medical Microbiology 14<sup>th</sup>edn. Churchill Livingstone London

#### REFERENCES:

- Morag, and Timbury, M.C, (1994). Medical Virology 10<sup>th</sup> edn. Churchill Livingstone.
- Dimmock, N.J., and Primrose, S.B., (1994) Introduction to Modern Virology 5<sup>th</sup> edn. Blackwell Scientific Publications, Oxford.
- Fenner, F. and White, D.O, (1994) Medical Virology, 5<sup>th</sup> edn. Academic Press, New York.
- Conrat, H.F., Kimball, P.C. and Levy, J.A., (1994) Clinical Virology, 3<sup>rd</sup>edn. Prentice Hall, New Jersey.
- S.J. Flint. (2009). *Principles of Virology*. 4<sup>th</sup> edn, ASM Press

#### REFERENCE JOURNAL

- Indian Journal of Virology (Springer)
- Journal of Virology (American Society for Microbiology)

#### E-LEARNING RESOURCES

- <https://viralzone.expasy.org/656>
- <https://www.sciencedirect.com/topics/neuroscience/dna-viruses>
- <https://www.sciencedirect.com/topics/immunology-and-microbiology/rna-viruses>
- <https://gmch.gov.in/e-study/e%20lectures/microbiology/10%20arboviruses.pdf>
- <https://www.britannica.com/science/antiviral-drug/anti-hiv-drugs>

#### COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Explain structure, genome replication and expression of viruses.
CO 2	Assess the pathogenesis of DNA viruses with their therapeutic possibilities of the present and future.
CO 3	Apply the information on pathogenesis, diagnosis for the treatment of RNA viruses.
CO 4	Evaluate the impact of arthropods on public health and emphasise on vector borne diseases prevention and control.
CO 5	Acquire skills on various diagnostics and therapeutic measures for viral diseases.

## CO MAPPING WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	1	2
CO 2	3	3	3	3	1	2
CO 3	3	3	3	3	1	1
CO 4	2	3	3	2	1	2
CO 5	1	2	3	3	2	2
Average	2.4	2.8	3	2.8	1.2	1.8

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K 1	A-10x2marks (Compulsory)	One or Two Sentences	20	100
K1, K2	B-5x8 marks  (8 questions will be given covering all Five Units)	500	40	
K3,K4	C-2 x20 marks  (4 questions covering any Four units will be given)	1200	40	



--	--	--	--	--

**SEMESTER VI  
INDUSTRIAL MICROBIOLOGY**

**TOTAL HOURS: 90**

**CREDITS: 5**

**COURSE CODE: MB18/6E/INM**

**LT P: 4-2-0**

**COURSE OBJECTIVES**

- 1.Introduce Microbial Fermentation mechanisms.
- 2.Understand Strain development strategies.
- 3.Learn Construction, Design and Operation of Fermenters.
- 4.Gain insight into Industrial Downstream process.
- 5.Acquire Knowledge about Industrial production of Microbial products.

**COURSE OUTLINE:**

**UNIT I:****10 Hours**

Introduction to Fermentation Processes - Components of Fermentation Process. Types of Fermentation Processes - Batch, Continuous, Surface, Submerged, Solid Substrate. Industrially Important Microorganisms.

**UNIT II:****20 Hours**

Strain Development and Media Formulation - Industrially Important Microorganisms - Isolation, Preservation and Improvement of Strains. Media Formulation- Crude Media Components, Antifoam agents, Buffering Agents. Sterilization -Batch and Continuous Process.

**UNIT III:****20 Hours**

Inoculum Development and Design of Fermentor - Development of Inoculum for various Fermentation Processes. Process Parameters - Aeration, Agitation, Temperature Regulation, Foam Regulation and pH Regulation. Fermentor: Basic Structure, Construction and Types - Typical Stirred Aerated fermentor, Tower fermentor, Airlift Fermentor.

**UNIT IV:****20 Hours**

Downstream Processing - Choice of recovery process, biomass separation from fermentation media- Precipitation, filtration, centrifugation, Cell disruption for intracellular products, solvent extraction and recovery, chromatography, membrane processes, drying, crystallization and whole broth processing. Industrial effluent treatment and quality assurance - GMP, QC of raw materials and Microbiological assays.

**UNIT V:****20 Hours**

Industrial Production - Antibiotics- Penicillin and Streptomyces, Amino acids - Glutamic acid and Lysine, Vitamins - Cyanocobalamine, Enzymes – Amylase -Alcoholic Beverages - Wine and Beer, Vinegar production, SCP - Baker's yeast.

**RECOMMENDED TEXTBOOKS:**

1. Stanbury, P. F., Whitaker, A., and Hall, S.T. (2017). Principles of Fermentation Technology 3rd edn. Pergamon press.
2. Reed. G (2004). Prescott, H., and Dunn's Industrial Microbiology, 4<sup>th</sup>edn. CBS publishers.
3. Patel A.H (2012). Industrial Microbiology. 2<sup>nd</sup>edn, Mac Millan India Pvt Ltd.

**REFERENCES:**

- 1.Casida L.E. (1968). Industrial Microbiology, John and Wiley Eastern Limited, New Delhi.
- 2.Sivakumar, P.K., Joe, M.M and Sukesh, K (2010). An introduction to Industrial Microbiology. 1<sup>st</sup>edn, S.Chand and Company Ltd, New Delhi.
- 3.Chandrakant, K. (2016). Pharmaceutical Microbiology. 1<sup>st</sup> edition, Nirali Publication.
- 4.Peppler H.J, and Periman D. (1979) Fermentation Technology, Vol 1 & 2, 2<sup>nd</sup>edn, Academic Press, London.
- 5.E1-Mansi, E.M.T., Bryce, C.F.A., Demain, A.L. and Allman,A.R. (2007). Fermentation Microbiology and Biotechnology. 2<sup>nd</sup> edition, CRC press, Taylor and Francis Group.

**JOURNALS:**

1. Journal of Industrial Microbiology and Biotechnology.
2. Journal of International pharmaceutical research.

## E-LEARNING RESOURCES

1. <https://www.generalmicroscience.com/industrial-microbiology/introduction-industrial-microbiology/>
2. <https://www.slideshare.net/rekharehmat/strain-improvement-technique>
3. <http://www.biologydiscussion.com/industrial-microbiology-2/fermentor-bioreactor-history-design-and-its-construction/55756>
4. <http://www.biologydiscussion.com/biotechnology/downstream-processing/stages-in-downstream-processing-5-stages/10160>
5. <https://sciencesamhita.com/industrial-products-from-microbes/>

## COURSE OUTCOME

CO No.	CO Statement
CO 1	Analyse various concepts in Industrial Microbiology and types of fermentation process.
CO 2	Gain Knowledge on Strain development strategies and industrial formulation of media.
CO 3	Acquire insights on design, construction and types of Fermenter.
CO 4	Identify the stages in industrial Downstream Process and effluent treatment.
CO 5	Discuss industrial production of microbial metabolites.

## MAPPING OF CO WITH PSO

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
<b>CO 1</b>	2	2	1	3	1	1
<b>CO 2</b>	1	2	1	3	2	1
<b>CO 3</b>	1	2	1	3	2	1
<b>CO 4</b>	1	2	1	3	2	1
<b>CO 5</b>	1	3	1	3	2	1
<b>Average</b>	<b>1.2</b>	<b>2.2</b>	<b>1</b>	<b>3</b>	<b>1.8</b>	<b>1</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**TEACHING METHODOLOGY:**

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

**QUESTION PAPER PATTERN**

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER VI  
MICROBIAL FERMENTATION TECHNOLOGY**

**TEACHING HOURS: 75  
CREDITS: 5**

**COURSE CODE: MB18/6E/MFT  
L T P: 4-2-0**

**COURSE OBJECTIVE:**

1. Learn about microbial fermentation technology.
2. Gain insight into strain development methods.
3. Understand about various types of Fermentors.
4. Impart knowledge about the techniques involved in product recovery.
5. Studying the production of bioproducts exploiting microorganisms.

**COURSE OUTLINE**

**UNIT I**

**10 Hours**

Introduction and history of fermentation technology. Components and types of fermentation process. Media formulation- crude media components, antifoaming agents, buffering agents. Sterilization Kinetics- batch and continuous process.

**UNIT II**

**20 Hours**

Isolation, improvement and preservation of industrially important strains. Microbial growth Kinetics- Batch and Continuous culture. Development of inoculum for various fermentation processes.

**UNIT III**

**20 Hours**

Design and operation of Fermentors – Basic Structure and parts of a Fermentor. Types -Stirred Aerator Fermentor, Acetator, Cavitator, Tower Fermentor and Air Lift Fermentor. Process parameters – Aeration, Agitation, Temperature, pH and Foam Regulation. Instrumentation Control, Fluid Rheology and Scaling Up. Achievement and Maintenance of aseptic conditions.

#### **UNIT IV**

**20 Hours**

Down Stream processing - Recovery and purification of fermentation products- Precipitation, filtration, centrifugation, Cell disruption for intracellular products, solvent extraction and recovery, chromatography, membrane processes, drying, crystallization and whole broth processing., Industrial Effluent Treatment and Quality Assurance.

#### **UNIT V**

**20 Hours**

Industrial production of antibiotics- penicillin, amino acids- glutamic acid, vitamins – cyanocobalamin, SCP- Baker's yeast, Alcoholic Beverages-Beer and Wine, Biofuel- methane from organic waste, Bioethanol and Biodiesel.

#### **RECOMMENDED TEXT BOOKS:**

1. Patel A.H. (2011). Industrial Microbiology. 5th edn. Macmilan education Ltd. London.
2. Prescott. L.M., Harley. J.P., Klein. D.A. (1993). Microbiology. 2<sup>nd</sup> edn. Wm. C. Brown publishers, Dubugue.
3. Stanbury, P.F, Whitaker A. and Halls S.J (1995). Principles of fermentation technology. 2<sup>nd</sup> edition. Pergamon press.

#### **REFERENCE BOOKS:**

1. Casida L.E. (1968). Industrial Microbiology, Wiley Eastern Limited, New Delhi.
2. Reed, G. (1982). Industrial Microbiology. Mac Millan Publishers Ltd., Wisconsin
3. Patel A.H. (1985). Industrial Microbiology. Macmillan India Pvt Ltd.
4. Pepler H.J, and Periman D. (1979) Fermentation Technology, Vol 1 & 2, Academic Press, London
5. Baumberg, S., Hunter, I.S. and Rhodes, P.M. (1989). Microbial Products - New approaches. Cambridge University Press, Cambridge, UK

#### **JOURNALS**

1. Journal of Industrial Microbiology and Biotechnology
2. Journal of International Pharmaceutical Research

#### **E- LEARNING RESOURCES**

- 1.[www.biologydiscussion.com/fermentation/fermentation-technology-meaning-methodology-types-and-procedure/17492](http://www.biologydiscussion.com/fermentation/fermentation-technology-meaning-methodology-types-and-procedure/17492)
- 2.<https://www.omicsonline.org/fermentation-technology/inoculum-development.php>
- 3.<http://www.biologydiscussion.com/industrial-microbiology-2/fermentor-bioreactor-history-design-and-its-construction/55756>.
- 4.<http://www.biologydiscussion.com/biotechnology/downstream-processing/stages-in-downstream-processing-5-stages/10160>.
- 5.<https://sciencesamhita.com/industrial-products-from-microbes/>

#### **COURSE OUTCOME**

<b>CO No.</b>	<b>CO Statement</b>
CO 1	Analyse various concepts in types of fermentation process
CO 2	Gain Knowledge on strain improvement strategies and growth kinetics
CO 3	Acquire insight on design, construction and types of Fermenter
CO 4	Identify the stages in industrial Downstream Process and effluent treatment
CO 5	Apply the information for production of microbial metabolites

### MAPPING OF CO WITH PO

<b>CO / PO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>
<b>CO 1</b>	2	2	1	3	1	1
<b>CO 2</b>	1	2	1	3	2	1
<b>CO 3</b>	1	2	1	3	2	1
<b>CO 4</b>	1	2	1	3	2	1
<b>CO 5</b>	1	3	1	3	2	1
<b>Average</b>	<b>1.2</b>	<b>2.2</b>	<b>1</b>	<b>3</b>	<b>1.8</b>	<b>1</b>

**KEY: STRONGLY CORRELATED – 3 MODERATELY CORRELATED – 2 WEAKLY CORRELATED – 1 NO CORRELATION – 0**

### TEACHING METHODOLOGY

Lecture by chalk and talk, flipped learning, OHP, e – content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	

<b>K1, K2</b>	<b>B-5x8 marks</b> (8 questions will be given covering all Five Units)	500	<b>40</b>	<b>100</b>
<b>K3, K4</b>	<b>C-2 x20 marks</b> (4 questions covering any Four units will be given)	1200	<b>40</b>	



**SEMESTER VI  
MAJOR PRACTICALS- I**

**MEDICAL MICROBIOLOGY**

**TOTAL HOURS: 90  
CREDITS: 4**

**COURSE CODE: MB18/6C/PR3  
LT P: 0-0-3**

**COURSE OBJECTIVES**

1. Develop skills to identify medically important bacteria, fungus and parasites from the clinical samples.
2. Gain an in depth knowledge on clinical sample processing.
3. Promote diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.

**COURSE CONTENT**

**BACTERIOLOGY**

1. General requirements for Collection and Transport of clinical specimens.
2. Gram's staining and Motility-Hanging Drop Method
3. Metachromatic granule staining, Capsule staining, Spore staining and Acid fast staining,
4. Isolation and Identification of Bacterial Pathogens from Clinical Specimens and their Biochemical reactions. -Urine, Pus, Sputum, Throat swab.
5. Isolation and Identification of Bacterial Pathogens from Clinical Specimens and their - Biochemical reactions. -Stool, Blood
6. Antimicrobial Sensitivity Testing-  
(i) Disk Diffusion Method (ii) Broth Dilution Method

**VIROLOGY**

1. Isolation of Coliphage from Sewage sample.
2. Demonstration of inclusion bodies – Negri bodies. Electron Micrograph pictures of Common Viruses.
3. Demonstration of Egg inoculation-CAM and Yolk Sac

## MYCOLOGY

1. Microscopic Examination of Fungi (LPCB Mount) causing Opportunistic Mycotic Infections  
i) Candidiasis ii) Aspergillosis iii) Zygomycosis.
2. Slide Culture Technique for Demonstration of Fungi.
3. Microscopic Examination of Fungi causing Dermatophytosis –  
*Microsporum sp., Trichophyton sp., Epidermophyton sp.,*
4. Carbohydrate Assimilation and Fermentation tests for Yeast
5. Germ tube test for Candida.

## PARASITOLOGY

1. Examination of Stool specimens for Parasites by Iodine Mount Techniques.
2. Concentration Methods for Stool specimens –Floatation Techniques- Saturated Salt and ZnSO<sub>4</sub>  
Floatation Method
3. Concentration Methods for Stool Specimens Sedimentation techniques- Formol Ether Method
4. Examination of Blood Smear for Malarial Parasites.
5. Examination of Permanent Slides- Scolex of Taenia, Proglottid of Taenia.

## COURSE OUTCOME

CO NUMBER	CO STATEMENT
CO 1	Acquire practical skills in the design and execution of experiments to identify bacteria from clinical samples.
CO 2	Evaluate various analytical methods to cultivate and assess the virus samples.
CO 3	Demonstrate various methods for isolation, detection and identification of fungus and parasites from clinical samples.

## CO MAPPING WITH PSO

CO NUMBER	PSO 1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1	2	3	3	3	2	2
CO 2	2	3	2	3	2	2
CO 3	3	3	3	3	2	3
Average	2.3	3	2.6	3	2	2.3

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY  
CORELATED-1 NO CORELATION-0**

**QUESTION PAPER PATTERN:**

**Time: 6 Hours (3 Hrs, Two days)**

**Max Marks: 60**

**Major practical : 25 marks**

**Minor practical : 15 marks**

**Spotters (5 x 2) : 10 marks**

**Record : 10 marks**

**SEMESTER VI  
MAJOR PRACTICALS- II  
APPLIED MICROBIOLOGY**

**TOTAL HOURS: 90**

**CREDITS: 4**

**COURSE CODE: MB18/6C/PR4**

**L T P: 0-0-3**

**COURSEOBJECTIVES:**

1. Learn the practical concept on isolation and identification of organisms from spoiled foods.
2. Outline the role of bacteria, its quantification and methods in detection, isolation and characterization from Milk and Curd.
3. Emphasizing the importance of Nitrogen fixing *Rhizobium* by its isolation from leguminous plants and demonstrating their effectiveness by seed inoculation.

**COURSE OUTLINE:**

1. Isolation and identification of microbes from spoiled fruits.
2. Isolation and identification of microbes from sea foods
3. Preparation of sauerkraut.
4. Detection of number of bacteria in milk by Breed's count
5. Detection of bacteria in milk by standard plate count method.

6. Dye reduction test - MBRT.
7. Litmus milk reaction.
8. Microbiological examination of curd - Gram staining.
9. Isolation of Lactobacilli from curd.
10. Enumeration of different Bacteria, Fungi, and Actinomycetes from soil.
11. Isolation of *Rhizobium* from root nodules and seed inoculation with *Rhizobium*.
12. Study of Azolla-Anabaena relationship
13. Isolation of antibiotic producers from soil by crowded plate technique.
14. Microbiological water analysis for potability – Multiple tube test
15. Water analysis for total bacterial population by standard plate count method.
16. Demonstration of membrane filtration technique.
17. Study of airborne microorganisms (bacteria and fungi) in different places by settle plate technique.
18. Immobilization of microorganism using gel entrapment method.

### COURSE OUTCOME

CO Number	CO STATEMENT
CO 1	Master the techniques on isolation and identification of microorganisms on spoiled foods.
CO 2	Apply practical knowledge to isolate bacteria present in milk and its products and studying both beneficial and harmful effects.
CO 3	Imbibe the practical skills for isolation of <i>Rhizobium</i> from leguminous plants and its efficacy in plant growth.

### MAPPING OF CO WITH PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO 6
CO1	2	2	2	3	1	1
CO2	2	2	2	3	1	1
CO3	1	2	2	3	1	2

Average	1	1.2	1.2	3	1	1.4
---------	---	-----	-----	---	---	-----

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**QUESTION PAPER PATTERN:**

**Time: 6 Hours (3 Hrs, Two days)**

**Max Marks: 60**

**Major practical : 25 marks**

**Minor practical : 15 marks**

**Spotters (5 x 2) : 10 marks**

**Record : 10 marks**

**COURSE PROFILE FOR ALLIED MICROBIOLOGY**

**SEMESTER III AND IV**

**(Offered to II B.Sc., Biochemistry students)**

COURSE	TITLE OF			TOTAL HOURS	L-T-P	CA	SA	TOTAL
--------	----------	--	--	-------------	-------	----	----	-------

<b>CODE</b>	<b>THE PAPER</b>	<b>CREDITS</b>	<b>HOURS/WK</b>					
MB18/3A/AM1	Allied Microbiology-I	4	4	60	3-1-0	40	60	100
MB18/4A/PR2	Allied Microbiology Practical	-	2	-		40	60	100
MB18/3A/AM2	Allied Microbiology-II	4	4	60	3-1-0	40	60	100
MB18/4A/PR2	Allied Microbiology Practical	2	2	60	0-0-2	40	60	100
	<b>TOTAL CREDITS</b>	<b>10</b>						

**SEMESTER III  
ALLIED MICROBIOLOGY- I**

**TOTAL HOURS: 60  
CREDITS: 4**

**COURSE CODE: MB18/3A/AM1  
L T P: 3-1-0**

**COURSE OBJECTIVES:**

1. Introduce History of Microbiology and classification of Microorganisms.
2. Understand Structural make up of Bacteria
3. Learn staining techniques and culturing bacteria.
4. Obtain pure culture of organisms and measure their growth.
5. Explain sterilization and preservation methodologies.

**COURSE OUTLINE:**

**UNIT I:**

**15 Hours**

Introduction to Microbiology - Theories of Biogenesis and Abiogenesis. Contributions of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Flemming, Joseph Lister. Classification of Microorganisms-Five Kingdom Concept.

**UNIT II:**

**15Hours**

Structural Characteristics of Bacteria - Morphology, Structure of Bacterial Cells - Capsule, Flagella, Fimbriae or Pili, Cell wall, Cell membrane, Mesosomes, Cytoplasm, Cytoplasmic Inclusions, Spores.

UNIT III: 10 Hours  
Basic Microbiology Techniques - Staining techniques - Simple and Differential Staining.  
Cultivation of Bacteria - Types of Media.

UNIT IV: 10 Hours  
Pure Culture Techniques - Serial Dilution, Spread Plate, Pour Plate Technique, Streak Plate.  
Measurement of Microbial Growth (Turbidity, Biomass and Cell Count).

UNIT V: 10 Hours  
Sterilization-Physical Methods - Heat, Filtration, Chemical Methods - Alcohols, Phenols,  
Radiation - UV and Gamma Rays. Preservation Techniques -Mineral Oil Method,  
Lyophilisation.

### **RECOMMENDED TEXTBOOKS:**

1. Pelczar M.J., Chan E.C.S. and Kreig N.R. (2010). Microbiology 5<sup>th</sup> edn, McGraw-Hill, New York Publications.
2. Prescott L.M, Harley J. P and Klein D.A. (2005). Microbiology 6<sup>th</sup>edn, McGraw-Hill Publications.
3. R.C.Dubey ,D.K.Maheshwari,( 2010) Microbiology 2<sup>nd</sup>edn , S.Chand and Company ltd. New Delhi.

### **REFERENCE BOOKS:**

1. Stanier R.Y, Ingraham, Wheelis M.L. Painter. (1999). General Microbiology, 5<sup>th</sup> edn, Mac Millan Press Ltd.
2. Tortora, G.J., Funke, B.R.,Case, C.L.( 2004). Microbiology- An Introduction, 8<sup>th</sup> edn, Benjamin-Cummings Pub Co.
3. Madigan M.T., Martinko J.M, Parker J. (2005). Brock - Biology of Microorganisms, 11<sup>th</sup> edn, Pearson Prentice Hall International, Inc.
4. Alcamo's Jeffrey, C.Pommerville. (2004). Fundamentals of Microbiology, 7<sup>th</sup>edn, Jones and Bartlett Publishers.
5. Ronald.M.Atlas. (1996). Principles of Microbiology, 2<sup>nd</sup>edn, Wm.C. Brown Publishers.

### **JOURNALS:**

1. **Indian Journal of Microbiology**
2. International Journal of Current Microbiology and Applied Sciences

### **E-LEARNING RESOURCES:**

1. [https://bio.libretexts.org/Bookshelves/Microbiology/Book%3AMicrobiology\\_\(Boundless\)/1%3A\\_Introduction\\_to\\_Microbiology/1.1%3A\\_Introduction\\_to\\_Microbiology/1.1B%3A\\_History\\_of\\_Microbiology\\_-\\_Hooke%2C\\_van\\_Leeuwenhoek%2C\\_and\\_Cohn](https://bio.libretexts.org/Bookshelves/Microbiology/Book%3AMicrobiology_(Boundless)/1%3A_Introduction_to_Microbiology/1.1%3A_Introduction_to_Microbiology/1.1B%3A_History_of_Microbiology_-_Hooke%2C_van_Leeuwenhoek%2C_and_Cohn)
2. <http://textbookofbacteriology.net/structure.html>
3. <https://milnepublishing.geneseo.edu/suny-microbiology-lab/chapter/differential-staining-techniques/>
4. <http://www.biologydiscussion.com/organism/culture-organism/obtaining-pure-culture-of-microorganisms-6-methods/55042>



5. <https://www.studyread.com/what-is-sterilization-methods/>

**COURSE OUTCOME:**

CO Number	CO STATEMENT
CO 1	Outline landmark events in the History of microbiology and to classify Microorganisms into taxonomic groups.
CO 2	Describe the structural make up and functional details of a Bacteria.
CO 3	Compile various staining and cultivation techniques.
CO 4	Expose to techniques for obtaining pure cultures of microorganisms and knowledge on methods of measuring microbial growth.
CO 5	Get acquainted with sterilization and preservation techniques.

**MAPPING OF CO WITH PSO**

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	1	1	1	1	1
CO2	3	1	1	1	1	1
CO3	2	1	2	1	2	3
CO4	2	2	1	2	1	2
CO5	1	3	1	2	1	1
AVERAGE	2.2	1.6	1.2	1.4	1.2	1.6

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**TEACHING METHODOLOGY:**

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

<b>Knowledge Level</b>	<b>Section</b>	<b>Word Limit</b>	<b>Marks</b>	<b>Total</b>
<b>K 1</b>	<b>A-10x2marks (Compulsory)</b>	One or Two Sentences	<b>20</b>	<b>100</b>
<b>K1, K2</b>	<b>B-5x8 marks</b>  (8 questions will be given covering all Five Units)	500	<b>40</b>	
<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	

**SEMESTER-IV**  
**ALLIED MICROBIOLOGY- II**

**TOTAL HOURS: 60**  
**CREDITS: 4**

**COURSE CODE: MB18/4A/AM2**  
**L T P: 3-1-0**

**COURSE OBJECTIVES:**

1. Investigate Microbial food spoilage, preservation and testing.
2. Analyse soil microorganisms and their applications.
3. Discuss sources of water, its purification and water borne diseases.
4. Summarize air profile, air quality and air borne diseases.
5. Learn industrial production of beneficial microbial products for human welfare.

**COURSE OUTLINE:**

**UNIT I:**

**15 Hours**

Food Microbiology-Microbial Spoilage of Food - Fruits, Vegetables, Cereals. General Preservation Techniques - High Temperature, Low Temperature. Microbiology of Milk - Microbes in Milk and their Sources. Pasteurization, Phosphatase test. Fermented milk products – Curd, Butter Milk, Cheese.

**UNIT II:**

**15 Hours**

Soil Microbiology - Microbes in Soil - Bacteria, Fungi, Actinomycetes, Algae and Viruses, Rhizosphere. Nitrogen Cycle, Carbon Cycle. Biofertilizers – Rhizobium

**UNIT III:**

**10 Hours**

Water Microbiology - Sources of Water, Potable Water, Municipal Purification of Water, Water Borne Diseases.

**UNIT IV:**

**10 Hours**

Air Microbiology - Composition of Air, Microbes in Air, Enumeration of Microorganisms in Air, Air Sanitation, Air Borne Diseases.

**UNIT V:**

**10 Hours**

Industrial Microbiology Microbes in the production of Organic acids – Citric acid, Antibiotics – Penicillin, Alcoholic Beverages - Wine and Beer. Regulatory bodies for Environment Pollution.

**RECOMMENDED TEXTBOOKS:**

1. Pelczar M.J., Chan E.C.S. and Kreig N.R. (2010). Microbiology, 5<sup>th</sup>edn, McGraw-Hill New York Publications.
2. Prescott L.M, Harley J. P and Klein D.A. (2005). Microbiology 6<sup>th</sup>edn, McGraw-Hill

Publications.

3. R.C.Dubey ,D.K.Maheshwari.( 2010). Microbiology 2<sup>nd</sup>edn, S.Chand and Company ltd.

### REFERENCE BOOKS:

1. Stanier R.Y, Ingraham, Wheelis M.L. Painter. (1999). General Microbiology, 5<sup>th</sup>edn, Mac Millan PressLtd.
2. Tortora, G.J., Funke, B.R.,Case, C.L.( 2004). Microbiology-An Introduction, 8<sup>th</sup> edn, Benjamin-Cummings Pub Co.
3. Madigan M.T., Martinko J.M, Parker J. (2005). Brock - Biology of Microorganisms, 11<sup>th</sup> edn, Pearson, Prentice Hall International,Inc.
4. Alcamo's Jeffrey, C.Pommerville. (2004). Fundamentals of Microbiology, 7<sup>th</sup> edn, Jones and Bartlett Publishers.
5. Ronald.M.Atlas. (1996). Principles of Microbiology, 2<sup>nd</sup>edn, Wm.C.Brown Publishers.

### JOURNALS:

1. Indian Journal of Applied Microbiology (IJAM).
2. International Journal of Microbiology Research.

### E-LEARNING RESOURCES:

1. <https://aggie-horticulture.tamu.edu/food-technology/food-processing-entrepreneurs/microbiology-of-food/>
2. <https://www.britannica.com/science/biogeochemical-cycle>
3. <https://www.disabled-world.com/health/water-diseases.php>
4. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=5229>
5. [https://bio.libretexts.org/Bookshelves/Microbiology/Book%3AMicrobiology\\_\(Boundless\)/17%3A\\_Industrial\\_Microbiology](https://bio.libretexts.org/Bookshelves/Microbiology/Book%3AMicrobiology_(Boundless)/17%3A_Industrial_Microbiology)

### COURSE OUTCOME:

CO Number	CO STATEMENT
CO 1	Focus on Microbial spoilage, preservation, testing and production of food products.
CO 2	Explain types of soil microbes with their role in the various Bio Geo cycles and their applications.
CO 3	Discuss the different sources of water , their purification methods and threats of water borne diseases.
CO 4	Explain the composition of air, its quality with remedial sanitary measures to combat air borne diseases.

CO 5	Get insights on industrial production of human utility products and regulatory bodies of Environmental pollution.
------	---

### MAPPING OF CO WITH PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2	3	1	3	1	3
CO2	3	3	2	3	1	2
CO3	1	2	1	2	1	3
CO4	1	1	2	2	1	2
CO5	1	2	3	3	1	3
AVERAGE	1.6	2.2	1.8	2.6	1	2.6

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

### TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning, Seminar.

### QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K 1	A-10x2marks (Compulsory)	One or Two Sentences	20	100
K1, K2	B-5x8 marks  (8 questions will be given covering all Five Units)	500	40	

<b>K3,K4</b>	<b>C-2 x20 marks</b>  (4 questions covering any Four units will be given)	1200	<b>40</b>	
--------------	--	------	-----------	--

**ALLIED PRACTICAL  
ALLIED MICROBIOLOGY  
(Offered to II B.Sc., Biochemistry students)**

**TOTAL HOURS: 60  
CREDITS: 2**

**COURSE CODE: MB18/4A/PR2  
L T P 0-0-2**

## **COURSE OBJECTIVES:**

1. Learn the basic concepts in Microbiology and instruments used in the laboratory.
2. Introduce staining techniques and culturing techniques.
3. Explain enumeration techniques, microscopic identification of microbes.

## **COURSE CONTENT**

1. Cleaning and preparation of Glassware.
2. Instrumentation- Incubator, Water Bath and Micropipette
3. Microscopy - Compound Microscope - Principle, Operation, Uses and Maintenance
4. Sterilization Techniques by Moist Heat and Dry heat method.
5. Simple staining
6. Gram staining
7. Capsule Staining
8. Preparation of Liquid and solid Media – Nutrient Broth & Nutrient agar
9. Demonstration of bacterial motility by Hanging drop method.
10. Enumeration of Bacteria from Air Samples- Standard Plate Count
11. Enumeration of Bacteria from Soil Samples- Standard Plate Count
12. Pure Culture Technique- Streak Plate technique
13. Methylene Blue Reduction test.
14. Observation of Pond Water for the Presence of Microorganisms- Volvox, Nostoc, Oscillatoria.
15. Identification of Organisms that spoil bread by LPCB mount technique
16. Antibiotic Sensitivity testing - Disc Diffusion method.

## **COURSE OUTCOME**

<b>CO No.</b>	<b>CO Statement</b>
CO 1	Imbibe complete knowledge on basic techniques in Microbiology
CO 2	Apply staining and culturing techniques for identification of microorganisms.
CO 3	Analyse the structure of Bacteria, Fungi and Algae microscopically

## **MAPPING OF CO WITH PSO**

<b>CO / PSO</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>	<b>PSO 5</b>	<b>PSO 6</b>
<b>CO 1</b>	3	3	1	1	1	1
<b>CO 2</b>	3	3	1	1	1	1
<b>CO 3</b>	3	3	1	1	1	1
<b>Average</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>

**KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0**

**QUESTION PAPER PATTERN**

**(Time-3hrs, One day)**

**Max Marks-60**

**Major practical : 30 marks**

**Minor practical : 20 marks**

**Record : 10 marks**